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Draft Environmental Impact Statement

APPALACHIAN INTEGRATED PEST MANAGEMENT (AIPM)

Gypsy Moth Demonstration Project

October 1988

4. AIPM Program would be implemented. The same tactics described in alternative 3 could be implemented in the General Project Area. In wilderness, monitoring would occur and if necessary, tactics that only affect gypsy moth could be used.

5. (Preferred Alternative). AIPM Program would be implemented. The same tactics described in alternative 3 could be implemented in the General Project Area. In wilderness, monitoring would occur and if necessary, tactics that only affect gypsy moth and biological tactics (includes Bt) could be used.

6. AIPM Program would be implemented. The same tactics described in alternative 3 could be implemented in the General Project Area and also in wilderness if necessary.

Comments must be received by: **DECEMBER 12, 1988**

SUMMARY

PURPOSE AND NEED

The primary purpose of this program Environmental Impact Statement (EIS) is to provide guidelines for tiering future site-specific analysis and additional National Environmental Policy Act (NEPA) documentation as needed for managing gypsy moth under the Appalachian Integrated Pest Management (AIPM) Gypsy Moth Demonstration Project in the 12.8 million-acre Project Area (figure I-1). This EIS is not site specific and does not fulfill NEPA requirements for taking actions at the project level. Site-specific analysis and appropriate NEPA documentation will be required once gypsy moth populations and specific management actions or alternatives have been identified. This EIS can be used for tiering when site-specific NEPA documents are prepared. In such cases, the issues in these documents can be narrowed to the proposed actions at the project level. Coordination with landowners and land managers is also required at the project level to ensure that proposed actions are consistent with the site management objectives and the managing agency's policies.

In 1985, an EIS was prepared for the current gypsy moth cooperative suppression/eradication program which includes many of the same tactics considered for use under AIPM. This EIS is needed because the AIPM Program is new and considered a significant Federal action that differs from the current programs. Differences between the 1985 EIS and addendum and this EIS are keyed to four facts:

1. This is a demonstration project and not a normal Forest Service or APHIS suppression or eradication project;

2. Low-level gypsy moth population intervention tactics are included;

3. This is a 100 percent-Federally funded project as opposed to cost-share projects between the Federal, State, and local governments and;

4. There are lands within the Project Area that may require several options within an alternative so a tactic or combination of tactics can be selected to be consistent with management objectives of these areas.

The AIPM Project has three objectives. First, it seeks to slow the spread and reduce adverse effects of gypsy moth within the project area. Second, the project is designed to develop and evaluate an integrated pest management (IPM) approach that can be implemented anywhere in the United States. Included are sampling methods, decision matrices for gypsy moth intervention activities, computer-based geographic information systems, and an educational program. Third, the project will develop and evaluate intervention tactics for the management of isolated gypsy moth populations within the Project Area.

The Project Area includes private, municipal, county, State and Federal land. All lands within the project area are eligible for treatment without cost to the landowner. However, participation in the project is voluntary.

BIOLOGY OF THE GYPSY MOTH

The gypsy moth was brought to the northeastern United States in 1869 from Europe. It has slowly spread south and west and has now spread into Virginia and West Virginia (figure I-2).

The gypsy moth causes its damage in the larvae or caterpillar stage, when the insects feed on foliage of susceptible vegetation. The larvae emerge from eggs about the time the first tree leaves come out in spring. The newly hatched larvae are very small. They climb to the top of trees, suspend themselves on a silken thread, and are blown by the wind to adjacent areas. This is how they spread naturally. They also spread artificially if egg masses are deposited on vehicles or forest products that are moved to uninfested areas. The larvae can emerge and cause an isolated infestation.

The larvae begin feeding and pass through stages increasing in size. Their preferred food is oak, particularly white oak. If an area becomes completely defoliated, larvae crawl to adjacent areas to feed.

The larvae complete their development by early July, emerging a final time as moths. The male moths emerge first and are strong fliers. Emerging females cannot fly. They crawl to suitable sites where they release a strong sex attractant called a pheromone. This chemical attracts the male to the female and they mate. Females deposit their buff-colored egg masses containing a few hundred to 1,000 eggs. The eggs hatch the following spring and the cycle is repeated. The size of egg masses give an indication as to the health of populations. Dime-size egg masses usually indicate declining populations, while quarter-size masses denote building populations.

Gypsy moth outbreaks occur in 5- to 7-year cycles on the average. The worst outbreak in history occurred in 1981 when almost 13 million acres were defoliated. Outbreak phenomenon is not fully understood, however, it is known that weather has an influence.

SCOPING

In March of this year, over 3,000 scoping letters were mailed. These letters asked the public to submit issues related to the proposed AIPM Project. In addition, the news media was provided with articles informing the public of the proposed project and how to become involved in the EIS process. A total of 312 letters were received. These letters were analyzed and five major issues were developed. They are:

1. Impacts of treatment on nontarget organisms;

2. Impacts of gypsy moth infestations;

3. Impacts on special management areas;

4. Effectiveness of intervention tactics;

5. Impacts to human health.

INTERVENTION TACTICS

The following intervention tactics can be used alone or in various combinations for managing gypsy moth populations as needed in the AIPM Project Area:

1. Disparlure. (Gypsy moth-specific tactic). This is the artificially produced gypsy moth sex attractant used to disrupt mating activity of small low-level populations. It is produced as 2" x 2" square plastic tape that is stapled to trees or as small 0.1" long flakes that are dropped on the area from aircraft. This tactic is often used following an earlier application of an insecticide.

2. Inherited Sterility. (Gypsy moth-specific tactic). This technique involves the partial sterilization of male moth pupae, which are mated with female moths in a laboratory. The females produce partially sterile eggs that are collected and dispersed in areas with low gypsy moth populations. Dispersal of these eggs can be done from the ground or air. The eggs hatch the following spring and the males mate with native females. The native females produce sterile eggs that will not hatch the following year.

3. Mass trapping. (Gypsy moth-specific tactic). The traps resemble milk cartons and contain the pheromone sex attractant. These are dispersed in an area containing low-level gypsy moth populations. Male moths are attracted and trapped by this device, thus inhibiting the mating cycle.

4. Nucleopolyhedrosis Virus (NPV). (Gypsy moth-specific tactic). This is a naturally occurring virus that affects only gypsy moth. It is produced artificially by the USDA Forest Service in limited quantities because of production and application difficulties. It is normally applied from the air and deposited on tree foliage. When gypsy moth larvae eat sprayed leaves, the virus causes the mortality of the larvae.

5. <u>Bacillus</u> <u>thuringiensis</u> (<u>Bt</u>). (Biological tactic). This is a naturally occurring bacteria that can also be produced artificially. It is normally applied from the air and deposited on tree leaves. When the gypsy moth larvae eat the sprayed leaves, the bacteria causes mortality of the larvae. The strains of bacteria used for gypsy moth control only affect Lepidoptera insects. <u>Bt</u> is normally used on moderate to high gypsy moth populations.

6. Diflubenzuron. This is a chemical insecticide. It is normally sprayed from the air and deposited on tree leaves. The gypsy moth larvae eats the leaves and the chemical inhibits the molting process, thus killing the insect. It can affect other arthropods that may ingest the chemical. Diflubenzuron is normally used on moderate to high gypsy moth populations.

7. Parasites and predaceous insects. This tactic involves the introduction of parasites and predaceous insects known to affect gypsy moth in areas with low gypsy moth populations. Some of these organisms only affect gypsy moth while others will attack various insects.

ALTERNATIVES

A total of 14 alternatives were considered in the EIS for the AIPM Program. Eight of these alternatives were eliminated for various reasons (page II-7). Six

alternatives were considered in detail, including the preferred alternative, alternative 5.

As stated, the EIS is for the AIPM Program. The selected alternative in this document will set the limits of what options and under what conditions those options can be used to manage gypsy moth within the AIPM Project Area. Before taking intervention action, further site-specific analysis and appropriate NEPA documentation will be prepared once specific gypsy moth infestations have been identified. This analysis will determine the appropriate option or combination of options to meet the suppression objectives based on the issues brought forth during additional scoping.

Not all lands will be treated if an alternative to implement the AIPM Program is selected. Participation by landowners and land managers in the AIPM Project Area is voluntary. Therefore, situations may arise where monitoring indicates a possible need for intervention, but landowner preference or managing agency policies prohibit or restrict any action. This situation is expected to occur on an area as large as the AIPM Project Area which contains diverse ownerships and land management objectives. Such complexity must be factored in to any forest pest management program. For this reason, the Program alternatives contain a range of options to accommodate landowners and land management agencies within the AIPM Project Area.

The Shenandoah National Park and Blue Ridge Parkway are included in the AIPM Demonstration Project and will participate in the project by having their Congressionally-mandated wilderness and lands zoned "natural" to be used to compare the rate of spread and impacts of gypsy moth in untreated areas to treated areas in the remainder of the Project Area. Research on impacts of the gypsy moth on native animal and plant populations in the Park will continue in these areas and some small scale methods improvement evaluations of gypsy moth-specific tactics might be conducted as well.

The six alternatives considered in detail are:

1. No action. The AIPM Program would not be implemented. Current suppression/eradication programs would continue.

2. In the General Project Area, the options available are to:

   a. Take no action, monitor only;

   b. Manage gypsy moth populations with gypsy moth-specific tactics;

   c. Manage gypsy moth populations with biological tactics;

   In wilderness, gypsy moth populations would not be managed.

3. In the General Project Area, the options available are to:

   a. Take no action, monitor only;

   b. Manage gypsy moth populations with gypsy moth-specific tactics;

   c. Manage gypsy moth populations with biological tactics;

   d. Manage gypsy moth populations with diflubenzuron.

In wilderness, gypsy moth populations would not be managed.

4. In the General Project Area, the options available are the same as alternative 3.

   In wilderness, the options available are to:

   a. Take no action, monitor only.

   b. Manage gypsy moth populations as necessary with gypsy moth-specific tactics.

5. In the General Project Area, the options available are the same as alternative 3.

   In wilderness, the options available are to:

   a. Take no action, monitor only;

   b. Manage gypsy moth populations as necessary with gypsy moth-specific tactics;

   c. Manage gypsy moth populations as necessary with biological tactics.

6. In the General Project Area, the options available are the same as alternative 3.

   In wilderness, the options available are to:

   a. Take no action, monitor only;

   b. Manage gypsy moth populations as necessary with gypsy moth-specific tactics;

   c. Manage gypsy moth populations as necessary with biological tactics;

   d. Manage gypsy moth populations as necessary with diflubenzuron.

Table II-4 (page II-25) provides a summary of the potential environmental consequences of each of these alternatives. Mitigating measures to reduce these potential impacts are on page II-32.

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CHAPTER I

PURPOSE AND NEED FOR ACTION

INTRODUCTION

This chapter presents an explanation of why the draft environmental impact statement has been prepared. It explains the purpose of the proposed action, scope, and the need for action. The proposed action that is addressed by the EIS is described, and the statutory authorities that apply to the EIS in relation to the proposed action are listed. The process used for identifying the major issues concerning the proposed action, as well as a summary of the issues themselves, is presented.

PURPOSE

The purpose of this programmatic EIS is to provide guidelines for future site-specific project analysis and National Environmental Policy Act (NEPA) documentation for the new 5-year Appalachian Integrated Pest Management (AIPM) Demonstration Project for managing gypsy moth. It is the initial step in the Program's compliance with NEPA. This EIS does not disclose site-specific environmental impacts. Subsequent environmental analysis and NEPA documentation will be tiered to this document and disclose the site-specific impacts of any proposed action under this Program. Relevant information and analysis contained in this document can be incorporated by reference when future environmental assessments or EIS documents are needed for site-specific projects to manage the gypsy moth in the AIPM Project Area. This will allow the issues in these documents to be narrowed to the proposed actions at the project level.

Alternative 1 is the no-action alternative, which would not implement the Program. Alternatives 2 through 6 would allow AIPM Program implementation. These alternatives identify a range of intervention tactics permitted in the Project Area to meet the Program's objectives and the conditions under which they may be implemented. The potential consequences to the environment of each alternative, if implemented, are analyzed and documented. Mitigation measures to reduce these potential impacts are also displayed.

SCOPE OF THE EIS

The Project Area includes all or portions of 18 counties in Virginia and 20 counties in West Virginia, totaling approximately 12.8 million acres (figure I-1). Within the area are the George Washington, Jefferson, and Monongahela National Forests, Shenandoah National Park and Blue Ridge Parkway. The project includes privately-owned land as well as municipal, county, State and Federal land. Cooperation of these landowners and managers is needed in coordinating activities proposed within the Project Area. All lands within the project area are eligible for intervention tactics without cost to the landowner. Participation in the project is is voluntary.

The AIPM project has three objectives. First, it seeks to slow the spread and reduce the adverse effects of gypsy moth within the project area. Second, the project is designed to develop and evaluate an integrated pest management (IPM) approach that can be implemented anywhere in the United States. Included are sampling methods, decision matrices for gypsy moth intervention activities, computer-based geographic information systems, and an educational program. Third, the project will develop and evaluate various intervention tactics for the management of isolated gypsy moth populations within the Project Area.

This draft environmental impact statement is not site specific. It is an EIS for the AIPM Program, and the potential impacts of six alternatives that could be implemented to manage gypsy moth populations within the AIPM Project Area are analyzed. However,

none of the alternatives require that intervention be taken. The decision to take action will be made at the project level following site-specific environmental analyses and further documentation under NEPA as needed. This EIS provides background information to which future project-level, site-specific environmental analyses and appropriate NEPA documentation can be tiered. Alternatives are described which include the Forest Service's preferred alternative and the no-action alternative. The EIS displays alternatives in terms of intervention tactics, impacts, and constraints. The affected environment is discussed, as well as the potential environmental consequences of implementing any of the alternatives.

The part of the Shenandoah National Park that is located in the eastern edge of the AIPM Project Area contains 53,919 acres of Congressionally mandated wilderness and 81,257 acres of land zoned "natural" by the National Park Service (NPS) will participate in the AIPM Project by serving as a comparison area. These areas will receive the same monitoring attention as the Project Area and will be used to compare the rate of spread and impacts of the gypsy moth in untreated areas to treated areas in the remainder of the Project Area. Research on impacts of the gypsy moth on native animal and plant populations in the Park will continue. The wilderness and natural zone areas may also be considered for small scale methods development applications (less than 3,000 acres total) of gypsy moth specific tactics such as the nucleopolyhedrosis virus (Gypchek). The use of gypsy moth specific methods may also be considered for use on other NPS natural zoned lands such as those segments of Blue Ridge Parkway which have been included as part of the AIPM Project Area.

The primary objectives of the project are to slow the spread and reduce the damage caused by gypsy moth defoliation irrespective of economic values. As such, an economic analysis is not appropriate. However, an economic accounting of the project will be conducted. The financial records will be maintained by year, by group or agency, and by type of activity. At the conclusion of the project, it will be possible using this system to determine the absolute costs of all project activities and the cost efficiency of the intervention tactics will be calculated.

NEED

Since its introduction to the United States in 1869, gypsy moth has defoliated forest and ornamental trees on over 93,000 square miles. In the 1987 Supplemental Appropriation, Congress funded a Forest Service project to slow the spread and to reduce the adverse effects of gypsy moth. In response, the AIPM Program was created to demonstrate the effectiveness of new and existing technology for managing the gypsy moth on Federal, State, and private lands within the AIPM Project Area. After an analysis of the planned activities and scope of the Project Area, it was determined that this was a major Federal action and that an EIS would be required under NEPA. The Forest Service is examining a range of alternatives for the AIPM Project Area for managing gypsy moth. Alternatives developed vary by the management objectives of land parcels within the project and by proposed intervention tactics. The Forest Service preferred alternative, as well as other alternatives and a summary of their impacts to the environment, are displayed in table II-4.

In 1985, the Forest Service and the Animal and Plant Health Inspection Service (APHIS) issued a final EIS, Gypsy Moth Suppression and Eradication Project (USDA FEIS, 1985). The 1985 EIS and subsequent addendum were developed by the Forest Service and APHIS for suppressing or eradicating gypsy moth infestations on Federal and non-Federal land in cooperation with State and Federal agencies. As appropriate, material from the 1985 EIS and addendum will be summarized and incorporated by reference in this EIS.

Differences between the 1985 EIS and addendum and this EIS are keyed to four facts: (1) this is a demonstration project and not a normal Forest Service or APHIS suppression or eradication project; (2) low-level gypsy moth population intervention tactics are included; (3) this is a 100 percent Federally-funded project as opposed to cost-share projects between the Federal, State, and local governments and (4) there are lands within the Project Area that may require several options within an alternative so a tactic or combination of tactics can be selected to be consistent with management objectives of these areas.

This EIS responds to the requirements of NEPA (40 CFR Parts 1500-1508), the Council on Environmental Quality (CEQ) regulations for implementing NEPA, the Department of Agriculture's procedures for implementing NEPA (7 CFR 1b), and Forest Service environmental policy and procedures (FSM 1950 and FSH 1909.15).

STATUTORY AUTHORITIES

The Forest Service is governed by the following laws that pertain to gypsy moth management:

1. The Cooperative Forestry Assistance Act (1978). This Act incorporates provisions of the repealed Forest Pest Control Act of 1947. The Act authorizes insect and disease management on Federally-owned forest lands and Federal/State cooperation in forest insect and disease management work.

   Because the Nation depends on non-Federal forest lands for timber and other forest resources, the Secretary of Agriculture is authorized to help control insects and diseases on forest lands of all such owners. Protection of forest resources helps enhance the growth and maintenance of trees and forests. This program also helps to promote the stability of forest-related industries.

2. The National Environmental Policy Act (1969, as amended 1982). Section 102(2)(c) of this Act requires that a detailed EIS be prepared for proposed major Federal actions that may significantly affect the quality of the human environment.

3. The Federal Insecticide, Fungicide, and Rodenticide Act (1984). This Act requires that insecticides used in suppression projects be registered by the Environmental Protection Agency (EPA).

4. The Wilderness Act (1964). Congress passed the Wilderness Act "to secure for the American people of present and future generations, the benefits of an enduring resource of wilderness." However, section 4(d)(1) states, "In addition, such measures may be taken as may be necessary in the control of fire, insects and diseases, subject to such conditions as the Secretary deems desirable."

5. The Endangered Species Act (1982). The purpose of this Act is "...to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species... "The Act further declares that "[it is] the policy of the Congress that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purpose of this Act."

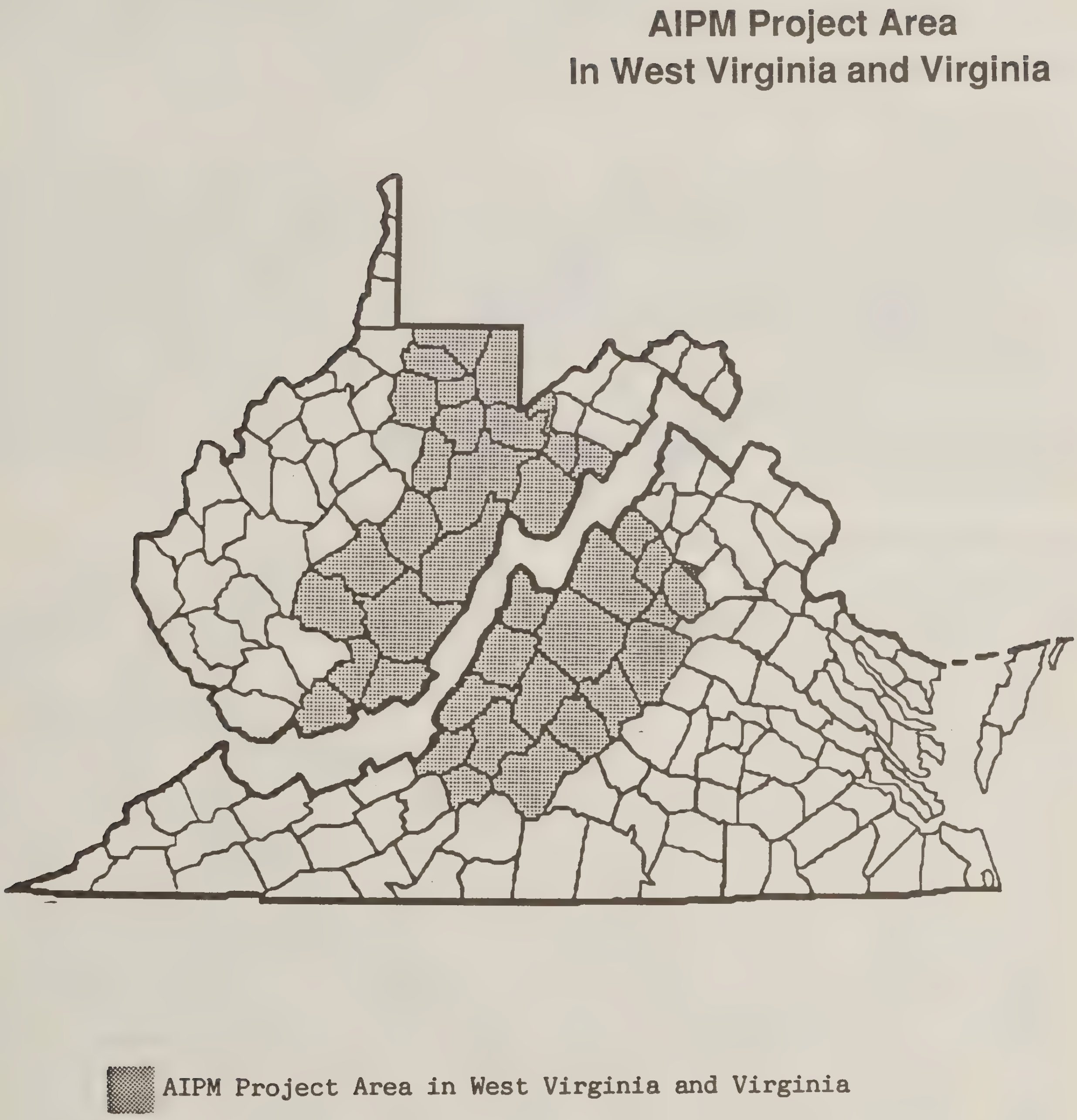


Figure I-1.--This Project Area includes 20 counties in West Virginia and 18 counties in neighboring Virginia.

6. The 1987 Supplemental Appropriations Bill. The Congress of the United States directed the Forest Service to develop an integrated pest management project aimed at slowing the spread and minimizing the adverse effects of the gypsy moth. The AIPM Gypsy Moth Demonstration Project was developed in response to this direction. The project is to apply existing knowledge and technology in the mountains of West Virginia and Virginia on Federal, State and private lands. The goal is to employ an integrated pest management approach to minimize adverse effects and to slow the spread of the pest through the area.

BIOLOGY OF THE GYPSY MOTH

Distribution

The gypsy moth (Lymantria dispar L.) is one of the most damaging insect pests of hardwood trees in the eastern United States. The gypsy moth was introduced into the Boston, Massachusetts, area in 1869 and has slowly become established north through all of New England and portions of southern Quebec, south to Delaware and Maryland and west through New York, Pennsylvania, northern Virginia, and northeastern West Virginia (figure I-2). Also, an isolated area in central Michigan has now become permanently infested. Movement of infested vehicles, equipment, and materials from the Northeast has resulted in isolated infestations occurring in such states as Arkansas, California, North Carolina, Oregon and Washington. Upon detection, all known isolated infestations have been treated for eradication by APHIS and cooperating State agencies.

Life Cycle and Biology

The gypsy moth produces one generation per year. Like other tree-defoliating insects, the gypsy moth does its damage during the larval stage. In the Northeast, larvae begin to emerge from egg masses in late April or early May. The first hatch is determined by temperature and usually coincides with budbreak of most hardwood trees. Egg hatch generally occurs in 3 to 5 days, but in some situations hatch may occur over a period of 2 to 3 weeks. The newly-hatched larvae are about 0.10 of an inch long and buff-colored, but turn black within a few hours. The larvae remain on or adjacent to the egg mass for several days if it is cold or raining. When conditions are favorable, the larvae climb to the tops of trees or other objects. They do not feed but suspend themselves on silken threads and are dispersed by the wind to adjacent trees or forests. The distance that the small caterpillars may be dispersed by the wind is a source of controversy. Early researchers were convinced that long-range dispersal was common in the northeast. However, Mason and McManus (1981) concluded that, in non-mountainous terrain, 99 percent of the larvae would be deposited within about 0.6 of a mile of their source. In mountainous areas, where turbulence and updrafts are more pronounced, an atmospheric dispersion model predicted that most larvae would land within 2 miles downwind (Mason and McManus 1981). Extensive aerial sampling of larvae over heavily infested ridges in Pennsylvania by Taylor and Reling (1986) suggests that about 3 percent may have the opportunity to travel up to 12 miles in one episode. This method of spread, which may last for 2 weeks, is the primary method by which the insect infests new areas. In addition, the movement of campers and outdoor furniture from infested areas to uninfested locations in the United States and Canada is often responsible for artificial introductions of the insect into new areas (McManus 1980). Larvae may go through several dispersals before landing on a suitable host where they begin to feed. As they feed, the larvae pass through several stages (instars), shedding their skin as they grow. Male larvae usually pass through five stages, and females through six. Depending on the temperature and available food, each stage lasts about 4 to 10 days.

Figure I-2.--Distribution and rate of spread of gypsy moth in the Eastern United States.

The larvae develop their characteristic markings by the fourth stage, consisting of five pairs of blue spots followed by six pairs of brick-red spots running down the larvae backs. At low-to-medium population levels, the larvae rest during the day under bark flaps or crevices, in cavities, or under broken limbs. It is thought that this cover protects them from natural enemies active during the day. If suitable sites are not found on the tree, the larvae will descend to the ground and rest under logs, rocks or other objects, where insects and small mammals may eat them. When populations are high, the larvae remain on the foliage and feed day and night. When hardwood trees are completely defoliated, the larvae move into adjacent woodlands in search of food (McManus 1980).

Depending on the geographic location in the East, most larvae complete their development by early July and undergo pupation in protected sites on trees or other objects. The brown-colored pupae are immobile and defenseless for about 2 weeks. The dark brown male gypsy moths emerge before the females, are strong flyers and are most active during the daylight hours. The heavy-bodied female moths are nearly white and cannot fly but crawl to suitable sites to lay their eggs. The females release a strong sex attractant to attract male moths to their site for mating. After mating, the females deposit their eggs in well-defined tan or buff-colored masses that may contain from a few hundred to nearly a thousand eggs. Soon after mating, the females die, but males survive for a few weeks. In about 6 weeks, the embryos develop into larvae that remain in the eggs during winter and hatch the following spring. The size of the egg masses in a given area provides information on the health of the population. Small egg masses, about the size of a dime, indicate that the population in the area is stressed and is on the decline. Such declines may be the result of lack of food, poor-quality food, or the build-up of a nucleopolyhedrosis virus (NPV) in the population. Large egg masses, about the size of a quarter or slightly larger, indicate a building population.

Feeding Activity

Upon landing on suitable foliage, the larvae begin feeding. First instar larvae chew small holes in the leaf and rest on a mat of silken threads on the underside of the leaf. Second and third instar larvae feed at the leaf margins and rest beneath branches and twigs. Larval behavior changes upon entering the fourth instar. The larvae feed at night and descend the tree to rest in protected locations throughout the day (McManus 1980). Feeding activity of light larval populations causes little noticeable defoliation in a forested community or hardwood stand. In comparison, defoliation by moderate populations is often evident in the upper crown portions of the tree or at the outer edges of the crown. Such trees are often interspersed among other hardwoods showing only light evidence of feeding.

Defoliation becomes very apparent early in the season in hardwood areas having heavy gypsy moth populations. Hardwood stands, especially those composed primarily of oak, appear essentially without foliage. Resistant hardwoods scattered throughout the stand, such as yellow-poplar or ash, exhibit normal foliage. Pine and hemlock trees are occasionally defoliated, as well as understory hardwood seedlings and shrubs. Usually, by mid-July, most of the defoliated hardwoods will refoliate, producing leaves that are smaller than normal and light green. Defoliated pines normally produce new foliage, while hemlocks remain defoliated and die. Many hardwoods that have had two seasons of defoliation may die.

Outbreak Cycles and Possible Triggers

Gypsy moth outbreaks are cyclic, in that populations periodically build to epidemic levels and then collapse. The first outbreak in North America occurred in 1889, about 20 years after the insect was introduced into the Boston, Massachusetts area. With the exception of the advancing front of the infested area, outbreaks may vary from 5 to 7 years or longer within the infested area. On the advancing front, populations may remain at outbreak levels for longer periods. Occasionally, an areawide population collapse will occur. A summary of gypsy moth defoliation by state from 1924 to 1987 is presented in table I-1. As indicated in the table, a record amount of defoliation was reached in 1981, when 12,872,725 acres were defoliated across the infested area of the Northeast. Populations and associated defoliation attained this level in 2 years, building from a low of 643,609 defoliated acres in 1979. After 1981, defoliation again began to decline to a low of 998,397 acres in 1984.

Many interacting factors contribute to the start of a gypsy moth outbreak in a given area. Gypsy moth outbreaks pass through four distinct phases or modes. They are:

1. Innocuous mode: Gypsy moth populations are stable at low levels. Predation by small mammals, birds, and insects, as well as insect parasitism, appears to play a major role in maintaining stable populations (USDA 1981; Campbell 1976).

2. Release phase: The exact causes which permit stable gypsy moth populations to begin building are not clearly understood. It is thought that populations build first in localized areas, having secure resting or hiding locations to escape enemies, adequate food and favorable climatic conditions before populations spread to adjacent areas. Favorable weather conditions, such as a mild winter followed by a warm dry spring and summer, increase larval survival and population expansion (USDA 1981; Campbell and Sloan 1977).

3. Outbreak mode: Gypsy moth populations build to high levels, and the larvae cause moderate to heavy defoliation of susceptible hosts over wide areas. Mortality caused by birds, mammals, insects, and parasites continue, but their impacts are minor. Toward the end of the outbreak, the gypsy moth virus (NPV) may begin to build in the population (USDA 1981; Campbell and Sloan 1977).

4. Decline phase: Gypsy moth populations begin to collapse as a result of overpopulation, characterized by gypsy moth virus, reduced production of offspring, and starvation. Parasites and predators apparently play a minor role in the decline of populations. Such populations may often be characterized as having more male than female adults (USDA 1981).

The factors that cause populations to grow from the innocuous mode to the outbreak mode are not completely known. Regional weather patterns may have a great influence on the release phase of the population. Mild winters followed by warm, dry spring periods favor survival of the overwintering egg masses and maximum survival of the early larval stages. Persistently low winter temperatures, such as -26 degrees Fahrenheit for 48 to 72 continuous hours, may cause heavy egg mortality (McManus 1980; USDA 1981). This is especially true if most of the egg masses are exposed or not covered by snow. Similar egg mortality may result when unseasonably warm days occur in the winter (70+ degrees Fahrenheit) and then are followed by an intense cold period. The larvae resume development within the eggs during the warm period and

Table I-1.—Summary of gypsy moth-caused defoliation (in acres) by State, 1924-1987

Year	ME	NH	VT	MA	RI	CT	NY	PA	NJ	DE	MD	MI	VA	WV	DC	TOTAL
24	71	591	0	163	0	0	0	0	0	0	0	0	0	0	0	825
25	0	239	0	48,321	0	0	0	0	0	0	0	0	0	0	0	48,560
26	1	960	5	78,193	1,663	0	0	0	0	0	0	0	0	0	0	80,822
27	4,985	3,923	2	131,880	126	4	0	0	0	0	0	0	0	0	0	140,920
28	5,575	119,757	3	137,121	58	0	0	0	0	0	0	0	0	0	0	262,514
29	15,187	440,845	0	95,078	23	0	0	0	0	0	0	0	0	0	0	551,133
30	55,174	205,125	0	27,856	66	5	0	0	0	0	0	0	0	0	0	288,226
31	20,938	96,690	277	86,694	114	8	0	0	0	0	0	0	0	0	0	204,721
32	42,298	43,287	1	200,387	376	46	0	0	0	0	0	0	0	0	0	286,395
33	19,718	216,669	2	157,003	4,292	46	0	0	0	0	0	0	0	0	0	397,730
34	60,403	285,880	25	128,237	17,750	66	0	0	0	0	0	0	0	0	0	492,361
35	92,630	330,195	106	106,097	10,908	833	0	0	0	0	0	0	0	0	0	540,769
36	80,944	192,114	0	152,469	3,095	0	0	0	0	0	0	0	0	0	0	428,622
37	140,026	72,973	81	393,613	2,063	4	0	0	0	0	0	0	0	0	0	608,760
38	120,432	34,122	416	154,348	3,297	1,339	0	0	0	0	0	0	0	0	0	313,954
39	202,193	136,772	5,311	143,292	848	4,224	0	0	0	0	0	0	0	0	0	492,640
40	204,041	152,797	3,160	125,586	52	0	0	0	0	0	0	0	0	0	0	485,636
41	122,386	80,579	980	263,369	707	0	0	0	0	0	0	0	0	0	0	468,021
42	850	6,963	49	36,715	0	0	0	0	0	0	0	0	0	0	0	44,577
43	10	290	0	34,481	64	0	0	0	0	0	0	0	0	0	0	34,845
44	21,221	2,346	210	225,637	640	14	75	6	0	0	0	0	0	0	0	250,149
45	210,881	58,517	93,950	456,832	1,280	16	0	11	0	0	0	0	0	0	0	821,487
46	203,813	183,943	15,900	217,132	1,645	486	0	0	0	0	0	0	0	0	0	622,919
47	0	166	0	7,256	0	0	0	0	0	0	0	0	0	0	0	7,422
48	60	21	0	32,386	0	0	0	0	0	0	0	0	0	0	0	32,467
49	0	8	0	78,665	0	0	0	0	0	0	0	0	0	0	0	78,673
50	2	12	0	4,979	0	375	0	0	0	0	0	0	0	0	0	5,368
51	8,195	2,478	1,108	3,185	0	5,673	675	0	0	0	0	0	0	0	0	21,314
52	82,715	94,975	26,985	82,372	0	6,005	0	0	0	0	0	0	0	0	0	293,052
53	174,999	209,335	120,787	917,996	0	56,215	7,745	0	0	0	0	0	0	0	0	1,487,077
54	170,485	154,015	24,650	118,095	0	13,848	10,355	0	0	0	0	0	0	0	0	491,448
55	10,810	14,975	8,875	0	0	6,842	10,559	0	0	0	0	0	0	0	0	52,061
56	7,285	9,305	12,635	3,830	0	3,458	6,645	0	0	0	0	0	0	0	0	43,158
57	120	0	495	16	0	4,909	858	60	0	0	0	0	0	0	0	6,458
58	0	0	0	8	0	117	0	0	0	0	0	0	0	0	0	125
59	1,000	4,000	1,500	382	0	5,980	1,605	0	0	0	0	0	0	0	0	14,467
60	6,350	4,600	6,132	150	0	15,000	16,490	0	0	0	0	0	0	0	0	48,722

—continued—

Table I-1.—Summary of gypsy moth-caused defoliation (in acres) by State, 1924-1987 (continued)

Year	ME	NH	VT	MA	RI	CT	NY	PA	NJ	DE	MD	MI	VA	WV	DC	TOTAL
61	21,340	621	11,834	3,000	0	0	30,685	0	0	0	0	0	0	0	0	67,480
62	3,998	3,390	6,292	150,000	0	83,290	61,342	0	0	0	0	0	0	0	0	308,312
63	1,970	8,345	12,020	87,847	0	40,140	22,600	0	0	0	0	0	0	0	0	172,922
64	0	14,509	23,523	20,787	375	98,552	97,237	0	0	0	0	0	0	0	0	254,983
65	190	8,451	2,903	17,232	50	86,009	148,366	0	0	0	0	0	0	0	0	263,201
66	30	20	650	500	110	15,895	34,655	0	5	0	0	0	0	0	0	51,865
67	825	561	2	909	150	2,731	46,160	0	1035	0	0	0	0	0	0	52,373
68	777	5,830	0	3,925	565	16,416	47,525	60	5,025	0	0	0	0	0	0	80,123
69	1,450	17,160	0	6,060	313	56,881	121,610	830	51,525	0	0	0	0	0	0	255,829
70	1,080	38,525	0	6,835	1,082	368,706	416,270	10,500	129,835	0	0	0	0	0	0	972,833
71	820	3,250	790	18,787	8,525	655,107	479,150	598,200	180,595	0	0	0	0	0	0	1,945,224
72	40	200	4,215	20,480	22,510	513,880	177,605	404,060	226,140	0	0	0	0	0	0	1,369,130
73	490	30	200	43,970	35,925	333,215	248,441	856,710	254,865	0	0	0	0	0	0	1,773,846
74	860	0	0	76,903	2,120	120,980	42,350	479,590	28,102	0	0	0	0	0	0	750,905
75	110	0	15	17,895	435	63,411	9,275	317,880	55,430	0	0	0	0	0	0	464,451
76	0	0	1,750	29,820	7,540	9,809	26,583	732,310	57,630	0	0	0	0	0	0	865,442
77	2,010	320	33,435	133,081	125	0	91,313	1,296,550	39,185	0	0	0	0	0	0	1,596,019
78	4,120	725	29,756	63,042	0	3,835	500,046	452,892	204,830	0	0	0	0	0	0	1,259,246
79	23,180	5,980	15,411	226,260	655	7,486	162,275	8,552	193,700	10	0	100	0	0	0	643,609
80	221,220	183,999	75,094	907,075	43,830	272,213	2,449,475	440,500	411,975	0	3	5	0	0	0	5,005,389
81	655,841	1,947,236	48,979	2,826,095	272,556	1,482,216	2,303,915	2,527,753	798,790	500	8,826	18	0	0	0	12,872,725
82	574,537	878,273	9,864	1,383,265	658,000	803,802	825,629	2,351,317	675,985	1,265	9,162	92	0	0	0	8,171,191
83	16,285	560	0	148,133	53,880	153,239	290,843	1,360,824	340,285	2,992	15,870	457	0	0	0	2,383,368
84	1,892	0	0	185,520	164,600	544	33,678	450,642	98,695	14,203	41,824	6,425	374	0	0	998,397
85	6,698	0	0	414,084	133,920	89,544	129,820	581,113	239,350	5,144	83,488	18,460	5,200	2,470	0	1,709,291
86	11,572	0	0	343,091	219,150	237,237	175,365	987,819	280,290	3,118	58,190	61,370	27,259	8,250	0	2,412,711
87	648	290	0	28,739	5,050	65,364	55,150	880,335	95,104	2,530	76,803	39,443	67,695	12,490	12	1,329,653
Total:	3,637,781	6,277,742	600,378	11,813,159	1,680,533	5,706,015	9,082,370	14,738,514	4,368,376	29,762	294,166	126,370	100,528	23,210	12	58,478,916

then are frozen by the following cold period. Weather conditions in the spring also influence the survival and development of larvae. Heavy larval mortality may occur when early instar larvae are subjected to extreme cold periods shortly after egg hatch. Larval development may also be slowed by periods of cool, wet weather that may occur in the spring. If these conditions delay bud break and leaf expansion on host trees, many of the larvae may starve. Unsuitable site and forest stand conditions may further limit population development, while stands that are composed primarily of preferred host species favor population development.

When the gypsy moth was introduced into this country from Europe in 1869, its complement of natural enemies was not included. Early in this century, efforts were made to introduce and establish parasites and predators from Europe and Asia. The native parasites and predators, together with those that were successfully introduced, are thought to be important in keeping gypsy moth populations at low levels between outbreaks. Parasites and predators, however, probably have little impact on populations in the outbreak mode (McManus 1980). In addition to the insect parasites and predators, birds, mammals, amphibians, reptiles, and invertebrates take their toll on the gypsy moth. About 38 or more species of birds feed on various stages of the gypsy moth. Similarly, 15 or more species of forest mammals include the gypsy moth in their diet.

Several natural diseases caused by viruses, bacteria, fungi, and microsporidia attack the gypsy moth. When populations are at outbreak levels, the most significant natural agent is the nucleopolyhedrosis virus (NPV), which may build up and initiate a total collapse of outbreak populations in a given area. Because of its effectiveness, it has been produced in the laboratory and developed into a biological insecticide, called Gypchek and registered with the Environmental Protection Agency (EPA).

Host Vegetation

Gypsy moth larvae can feed on at least 500 species of trees, shrubs, and vines commonly found in the eastern United States. Preferred hosts are oak species, especially white oak. Additional hosts include apple, basswood, gray and river birch, sweetgum, hawthorne, aspen, beech, and willow. Less desired but still attacked are black birch, yellow birch, paper birch, cherry, cottonwood, elm, sassafras, spruce, and pine. Older gypsy moth larvae feed on the foliage of several species that younger larvae normally avoid, particularly hemlock, pine, and spruce. The gypsy moth avoids ash, balsam fir, butternut, black walnut, catalpa, red cedar, flowering dogwood, American holly, locust, sycamore, yellow poplar, and shrubs such as native laurel, rhododendron and arborvitae. During outbreaks, however, gypsy moths will feed on almost all vegetation (McManus 1980).

The impact of gypsy moth defoliation on a forest stand depends upon the abundance of host trees and on site and stand conditions. Throughout the infested Northeast, the insect prefers to feed on oaks. Vigorous oaks and other hardwoods can normally withstand one or two consecutive defoliations, but suppressed trees and those in poor condition may die after one defoliation. When susceptible oak or other hardwoods are stripped of more than 50 percent of their leaves, the tree usually refoliates by mid-summer. Production of new foliage puts additional stress on the tree, further depleting its stored food reserves. Previously stressed trees or those weakened by other agents may have insufficient food reserves to completely refoliate, and many of the upper crown branches die. Defoliation during periods of drought intensifies the stress, often resulting in extensive tree mortality. Weakened trees are usually attacked and killed by opportunistic organisms, such as the shoestring fungus (*Armillariella mellea*) and the two-lined chestnut borer (*Agrilus bilineatus*) (McManus

1980; Wargo 1977). Depending on its intensity, defoliation may also reduce the trees' growth by 30 to 50 percent. If gypsy moth populations collapse and no defoliation occurs in the following 1 or 2 years, most stressed trees will survive and regain their former growth rates.

Mortality of overstory hardwoods may result in changes in stand composition, depending on the site. Such mortality may encourage red maple, yellow poplar, white pine or other species to proliferate in such areas. In some cases, the changes in stand composition may be regarded as beneficial, since such areas may become less susceptible to future gypsy moth defoliation. These new stands may, however, be less valuable for wildlife and for timber production.

CURRENT SITUATION

Current Programs

USDA Forest Service Suppression - The Cooperative Forestry Assistance Act of 1978 (P.L. 95-313) provides authority for Federal/State cooperation in forest insect and disease management. The Secretary of Agriculture is authorized to assist in the control of pest outbreaks on non-Federal forest lands of all ownerships. A principal USDA goal is to assure an adequate supply of high-quality food and fiber and a good environment for the American people. The USDA gives special emphasis to the development and use of efficient and environmentally acceptable integrated pest management (IPM) programs. All methods, including the use of chemical pesticides, are considered in IPM projects.

Forest Service policy is to protect and preserve the forest resources of the Nation against destructive insect and disease pests. Pest outbreaks are prevented or suppressed by methods that will restore, maintain, and enhance the quality of the environment. These objectives are attained on non-Federal lands through cooperation with State foresters or equivalent State officials. Pests are suppressed directly on National Forest System lands and in cooperation with responsible officials on other Federal lands.

Projects approved for cooperative financing must meet Forest Service standards for environmental, biological, and economic acceptability and the Federal role criteria (Forest Service Manual, Title 3400). Approval is based on the results of an environmental analysis conducted in accordance with NEPA and its implementing regulations.

Cooperative projects are aimed at meeting the short-range objectives of suppressing moderate to high-level gypsy moth populations and at preventing excessive defoliation and tree mortality in forested residential areas, State or municipal parks or high-value forest stands. Such projects are not aimed at treating low-level populations to reduce the spread of the gypsy moth into new areas. Rather, private landowners, towns or communities have the option of not participating in cooperative State suppression projects. No attempt is made to eradicate the insect or treat all of the infested areas (USDA FEIS 1985).

USDA Animal and Plant Health Inspection Service (APHIS) Eradication and Regulatory Programs - APHIS has the responsibility and authority to conduct programs against the gypsy moth throughout the United States. The agency authority is derived from the Plant Quarantine Act of 1912 as amended (7 USC 151-165, and 167); The Federal Plant Protection Act of 1957 (7 USC 150aa-150jj); and the cooperation with States in administration and enforcement of certain Federal laws approved September 2, 1963 (7 USC 450). These acts authorize, among other things, the development of APHIS

activities for the regulation of the artificial spread of the gypsy moth from the quarantined areas, and the eradication of isolation gypsy moth infestations outside this area.

The goal of the APHIS Cooperative Regulation Program is two-fold: to retard or prevent the artificial (man caused), long-distance spread of the gypsy moth and to eradicate detected isolated infestations. To control the moth's spread, regulations are enforced on area-to-area movement of articles that might contain eggs, larvae, pupae or adults. APHIS is also charged with detection and eradication of infestations, subsequently established as a result of the artificial movement of gypsy moth from area to area. Gypsy moth surveys provide information about pest distribution that serves to guide both regulatory and eradication activities (USDA FEIS 1985).

As a general rule, Federal participation in eradication projects will only occur when gypsy moth populations are identified that are: (1) geographically separate from areas known to be generally infested; (2) the result of artificial spread as opposed to natural spread; and (3) well defined by delimiting traps (USDA FEIS 1985). In contrast to cooperative suppression projects, APHIS cooperative eradication projects attempt to treat all of the infestation in a given area and provide private landowners no option for non-participation.

Status of Gypsy Moth Populations

In 1987, gypsy moth defoliation in the Northeast totaled 1,329,653 acres, down from a total of 2,412,711 acres in 1986. It is unknown if the indicated downward trend will continue through 1988 (table I-1). While populations have declined within the generally infested area, defoliation continues to increase along the advancing front of the infestation in central Maryland, western Pennsylvania, northern Virginia and northeastern West Virginia.

The gypsy moth continues to spread into uninfested areas along the advancing front, even though State/Federal suppression projects have been conducted in or adjacent to these areas. Natural spread continues because current cooperative suppression normally provides for treatment of areas having high populations (more than 250 egg masses/acre). Treatment areas are generally forested residential and suburban communities, recreation areas, parks or high-value forest stands. Areas that do not meet the above criteria remain untreated. Because much of the infestation in any given State remains untreated, the natural spread of the insect continues unimpeded. This is currently the situation adjacent to the northern boundary of the AIPM Project Area.

SCOPING

Process

The scoping process is used to determine the significant issues, concerns, and opportunities to be analyzed. The process began with a decision by the Forest Service to prepare the EIS. A "Notice of Intent" to prepare an environmental impact statement was published in the Federal Register on March 10, 1988. A scoping letter was prepared by the EIS Team in March 1988 which described the origin, location, and objectives of the AIPM Gypsy Moth Demonstration Project. The scoping letter requested public input on relevant issues, concerns, or opportunities related to the proposed AIPM Project. The letter was sent to Federal, State and local agencies, conservation and environmental groups, and interested and affected individuals located in and around the proposed Project Area in Virginia and West Virginia.

Addresses on land management planning mailing lists from the George Washington, Jefferson and Monongahela National Forests and a mailing list from the Shenandoah National Park were used. More than 3,000 letters were mailed on March 18, 1988.

In addition, a news release was provided to newspapers in and around the Project Area. The news release discussed the AIPM Project and provided information similar to the scoping letter. All individuals who submitted issues to be considered in the analyses were placed on the mailing list to receive additional information, including the draft EIS, final EIS, and Record of Decision.

A total of 312 responses was received. Public issues, management concerns, and opportunities (comments that offered solutions or possible action) were identified and reviewed by the AIPM Gypsy Moth EIS team. A second interdisciplinary team of Forest Service specialists reviewed the public responses to the scoping letter to identify issues, concerns, and opportunities to ensure that all significant issues were identified. Both sets of issues, concerns, and opportunities were blended into similar topic areas to create major issue statements. The major issue statements are composed of smaller issues that incorporate what the public, State, and Federal agencies wrote about the topic.

Major Issue Statements

1. Impacts of Treatment to nontarget Organisms. There is concern that intervention activities proposed by the AIPM Gypsy Moth Demonstration Project could have adverse impacts on nontarget organisms. In this project, living organisms, other than Gypsy Moth, such as threatened and endangered species, Lepidoptera species, wildlife and game species, are considered as potential nontarget organisms. Many public comments addressed concern for potential adverse impacts to water quality, particularly regarding biological or chemical insecticide applications. This concern was for organisms dependent upon water sources that could be impacted, such as fish, wildlife, and aquatic insects. Comments concerning water quality have been interpreted to mean concern for nontarget organisms.

2. Impacts of Gypsy Moth Infestation. There is concern about the potential impacts of gypsy moth infestation spreading through the Appalachian Mountains. Comments were received indicating a fear that gypsy moth infestations would result in catastrophic environmental impacts. The public questioned how these impacts might be minimized. Other comments indicated that the threat of gypsy moth infestation impacts are overestimated, and, since we cannot eradicate the pest, why go to the expense of treating or suppressing it?

3. Impacts on Special Management Areas. Concerns about impacts to special management areas such as wilderness and designated natural areas, threatened and endangered species habitat, park lands, research natural areas, and private land were received.

4. Effectiveness of Intervention Tactics. The effectiveness of proposed intervention tactics is also a concern to total success of the Project. Comments were received that indicate a need to treat all lands in the Project Area, and these comments questioned the voluntary aspects of the program where landowners and managers can decline to participate in intervention tactics which could possibly affect the success of the program. Coordination of the various agencies involved and the proper application of various intervention tactics were also commented on as being necessary for effective

gypsy moth management. Comments were received for increased research regarding non-traditional management tactics due to a concern that gypsy moth might become resistant to existing chemical insecticides registered by EPA for gypsy moth control.

5. Impacts to Human Health. There is concern that intervention activities (primarily the use of chemical insecticides) could have adverse impacts to humans. Comments addressed health hazards related to contamination of ground water and drinking water, food supplies (edible wild plants and animals as well as domestic ones), and general risk to humans. A few specific comments were received questioning the possible carcinogenic effects from the use of chemical insecticides.

A need to initiate an information and education program throughout the AIPM Project Area was identified. A number of comments raised the concern that the program and how it differs from existing suppression and eradication programs is not fully understood by the public . There is a certain amount of public apprehension about proposed intervention tactics within the AIPM area which needs to be addressed. A concern that small, private landowners be able to participate in the proposed program also surfaced.

Steps have been taken to enhance public awareness of the Project and Project activities. A full time Public Affairs Specialist has been hired to coordinate all public affairs activities. In addition, an Information Team has been appointed,consisting of the Public Affairs Specialists from the George Washington, Jefferson and Monongahela National Forests, the Shenandoah National Park and the Extension Services of Virginia and West Virginia. These individuals will conduct the public affairs and public involvement activities in their own local areas. Project information will be available through all these sources and will include such items as news releases, flyers, audio/visual packages and the availability of speakers for schools, groups and clubs. As a part of public involvement in the development of the NEPA documentation for this project, public meetings and forums will be arranged and conducted.

ALTERNATIVES, INCLUDING THE PROPOSED ACTION

CHAPTER II

ALTERNATIVES, INCLUDING THE PROPOSED ACTION

INTRODUCTION

This chapter provides a description of the survey and monitoring process and descriptions of the various intervention tactics that could be used under the various alternatives. It also briefly describes alternatives that were considered but eliminated from detailed study. The alternatives considered in detail are described, and a comparison of alternatives is presented. Finally, mitigating measures that will minimize the potential impacts of these alternatives are listed.

SURVEY AND MONITORING OF GYPSY MOTH POPULATIONS

A key component of IPM is pest population monitoring. In 1988 the AIPM Project Area was overlaid with a 1-kilometer (km) grid established on Universal Transverse Mercator (UTM) coordinates. A monitoring system has been established at 3km intervals along this grid in West Virginia and at 2km intervals in Virginia. Monitoring points, established near intersections of grid lines, will have a milk carton pheromone trap attached to a tree to trap male moths. At a subset of points, stand conditions will be recorded and evaluated to determine susceptibility to defoliation (Valentine and Houston 1984), as well as potential tree mortality during a gypsy moth outbreak, using a hazard rating system developed by Herrick and Gansner in 1986. Monitoring between 2 or 3km grid points may be more intensive (e.g. 1km intervals) on a site-specific basis, depending on land use and cover types. The monitoring system is designed to provide detailed information about gypsy moth populations within the Project Area. Figure II-1 displays approximate area within the AIPM Project where multiple male gypsy moths were trapped in 1988.

During the fall and winter, egg mass samples will be taken in 1km grid cells which lie within areas having greater than 200 male moths captured in pheromone traps. Within each cell, egg mass samples will be taken on a transect. Once the transect has been defined, a 5-minute walk sample will be taken and the number of egg masses observed during the walk will be recorded. At the end of the walk, a 40th acre fixed radius egg mass sample will be taken. The same transect will then be followed for another 5 minutes without recording egg mass numbers. At the end of 5 minutes, another 5-minute walk with counts and a fixed radius plot sample will be taken. A minimum of 3 pairs of timed walks and fixed radius egg mass samples will be taken in each 1km cell. This information will be used to estimate egg-mass densities and delineate boundaries of potential problem areas. Field crews will collect representative numbers of egg masses from infested areas in late winter for laboratory analysis. The analysis will determine the number of eggs/mass, percent-viable eggs/mass and the percent of eggs parasitized/mass. This analysis will provide information on the quality of the population. This information, along with the monitoring data, will be used to help determine if intervention is appropriate and if so, what intervention tactic or tactics may be employed. Data to be collected will include:

- Egg mass density and quality
- Male moth captures
- Population trends (egg mass, male moth)
- Parasite and disease incidence
- Defoliation estimates
- Size of infestation
- Proximity to other infested areas
- Stand susceptibility to defoliation
- Hazard rating
- Environmental sensitivity
- Vegetative cover type
- Land-use category

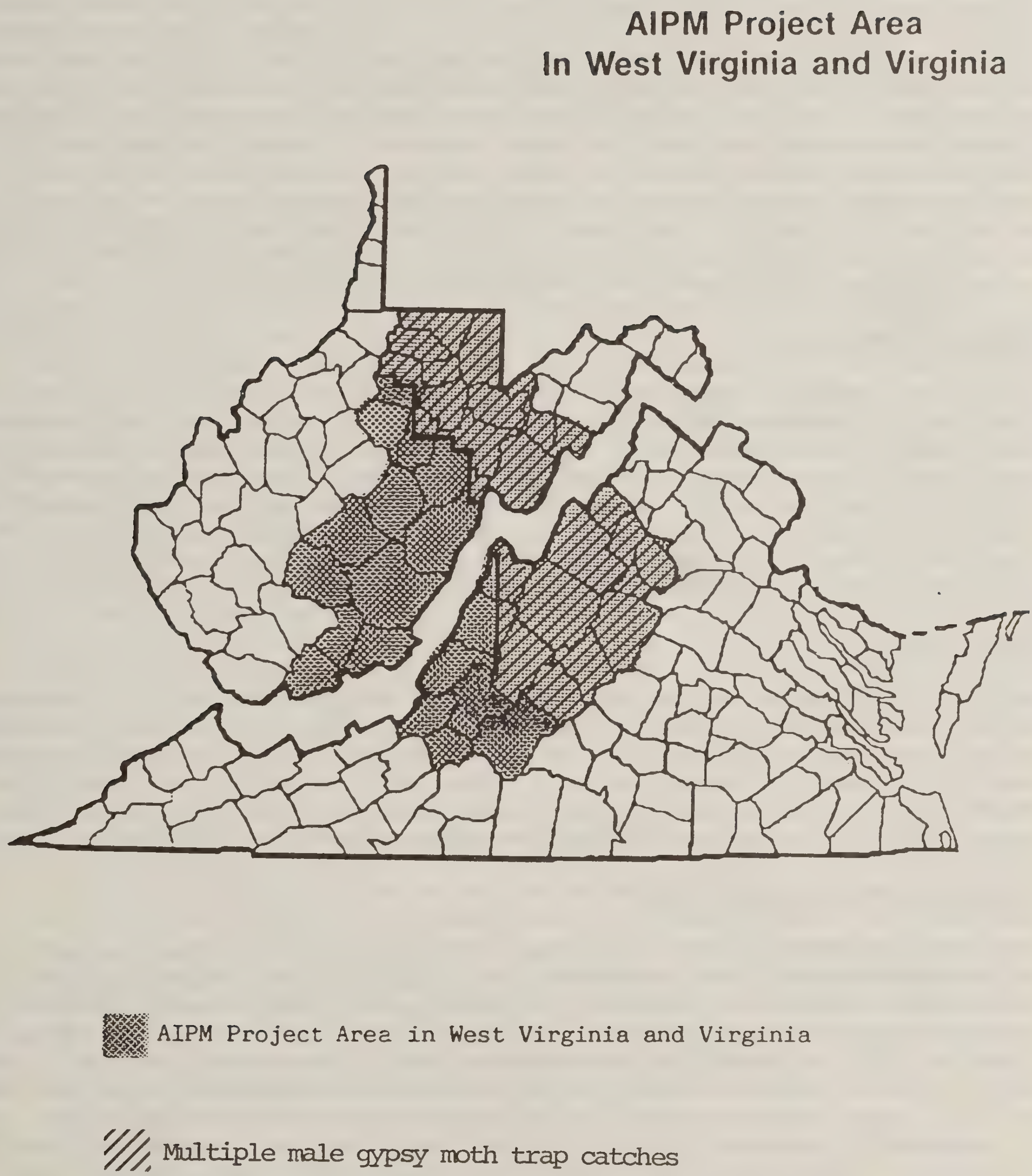


Figure II-1.—Counties in the AIPM Project Area where multiple male gypsy moths were trapped in 1988.

DESCRIPTION OF INTERVENTION TACTICS CONSIDERED IN ALTERNATIVES

Disparlure

Considered a gypsy moth specific intervention tactic, this is a synthetic formulation of the female gypsy moth sex attractant pheromone. The formulation, called disparlure, is used in two forms. The first is a laminated polymeric dispenser, or tape, for slow release of the attractant. It is manually attached to trees (one 2" x 1.5" strip placed approximately 5 feet above ground) in a grid pattern (approximately 40 per acre), generally in small areas with low-level populations. The second form of disparlure is a commercial product consisting of fine (about 0.1" long) polymeric flakes impregnated with the gypsy moth pheromone. Normal use involves the aerial application of the material over large areas. These products are used to disrupt mating communications between the sexes and may be used alone or in combination with an earlier application of an insecticide. Both disparlure products are normally used in areas where there are less than 25 gypsy moth egg masses per acre. Organisms other than gypsy moth are not affected by this tactic.

Inherited Sterility

This tactic involves mating sub-sterilized male moths with normal females in the laboratory. The resultant egg masses are then introduced into small areas having light populations, using ground application. Larger areas may be treated by aerial application. Eggs hatch in the spring, larvae (male and female) feed on available foliage, pupate and emerge as adult moths. These moths (male and female) mate with the native gypsy moth population, producing sterile eggs that will not hatch. This tactic is normally used when there are less than 100 gypsy moth egg masses per acre. Organisms other than gypsy moth are not affected by this tactic.

Mass Trapping

This tactic involves the use of large-capacity traps (resembling a half-gallon milk carton) baited with the female gypsy moth sex-attractant pheromone. Traps are placed in an intensive grid pattern to capture male moths before they mate with females. It may also be used in combination with earlier applications of an insecticide. This tactic normally can be used in small areas when there are less than 25 gypsy moth egg masses per acre. Organisms other than gypsy moth are not affected by this tactic.

Nucleopolyhedrosis Virus (NPV)

The nucleopolyhedrosis virus is a naturally-occurring virus that causes a disease (often referred to as "wilt" disease) of the gypsy moth. Currently, a formulation of NPV called "Gypchek" is produced in limited quantities by the USDA Forest Service. The gypsy moth NPV (Gypchek) was registered by the US Environmental Protection Agency (EPA) in 1978 for aerial application to suppress gypsy moth populations. The insecticide is prepared from gypsy moth larvae that have been inoculated and killed by NPV. The active ingredient in the gypsy moth NPV formulation is the virus, which is imbedded in a protein particle called the polyhedron. The powder formulation contains the virus and a small amount of insect parts (Podgwaite and others, 1983).

The effectiveness of the gypsy moth NPV, like most biological insecticides, is dependent upon proper application and timing. The efficacy of the NPV formulation is also more dependent upon weather conditions, especially rain and ultraviolet light, than chemical insecticides. The gypsy moth NPV formulations should be applied when the larvae are small (first and second instar) and foliage expansion on susceptible

host trees is at least 30 percent. Since the gypsy moth NPV formulation is a stomach insecticide, the larvae must ingest the virus along with the foliage. After ingestion, the virus is liberated from the polyhedra and attacks internal tissues and organs, multiplying rapidly and causing disintegration and death. This process, depending on temperature, generally takes 10 to 14 days. In general, the virus works best in moderate to heavy gypsy moth populations. Operationally, two applications of the virus are currently used; they are applied 7 to 10 days apart for maximum effectiveness.

The gypsy moth NPV formulation can be used as an intervention tactic by itself, or in combination with other techniques, such as later applications of disparlure. Organisms other than gypsy moth are not affected by the tactic.

Bacillus thuringiensis (Bt)

Bacillus thuringiensis, commonly known as Bt, is a naturally-occurring, spore-forming, crystal-producing, rod-shaped bacterium. There are numerous varieties of Bt; however, the variety that is registered for the control of various agricultural and forest Lepidoptera, including the gypsy moth is Bacillus thuringiensis Berliner, variety Kurstaki, strain HD-1. Another strain of Kurstaki, called NRD-12, is being developed and may soon be registered for use against the gypsy moth. In field tests, this strain seems to be more effective against this insect that the HD-1 strain. Neither the HD-1 nor NRD-12 strains of Bt are known to have any effect on aquatic diptera. However, a different variety of Bt, called Israeliensis, is registered for use in the control of mosquito and black fly larvae. This material will not be used as an intervention tactic for gypsy moth in the AIPM Project. When these strains begin to form spores, they produce protein crystalline bodies that contain delta-endotoxin, a natural substance that is toxic to Lepidopterous insects. Commercial formulations of Bt contain the spores and crystals as their primary ingredients. When ingested by larvae, the crystals dissolve in the alkaline gut, releasing the toxic protein. The protein breaks down the lining of the gut, causing the insect to cease feeding. The bacterium then invades the internal tissues of the larvae, multiplies rapidly and causes organ disintegration. Death of the larva is caused by a combination of bacterial infection and starvation, usually within 7 to 10 days (USDA FEIS 1985; Dubois and Lewis 1981).

The effectiveness of Bt is also dependent upon proper application and timing as well as weather conditions. It may be applied from the ground or air at various rates in light or heavy gypsy moth populations. Generally, Bt should be applied when the majority of the larvae are in the second instar and leaf expansion on susceptible host trees is 25 to 50 percent. In heavy gypsy moth populations, two applications may be needed to reduce larval populations and prevent defoliation. Bt may be used as an intervention tactic by itself or in combination with other techniques, such as later applications of disparlure. Nontarget Lepidopterous (moths and butterflies) insects may be impacted by this tactic if actively feeding in the treated area within 14 days after application. Additional information on both NPV and Bt is presented in "Gypsy Moth Suppression and Eradication Projects"; FEIS 1985.

Diflubenzuron

Diflubenzuron is a urea-based chemical insecticide manufactured and sold under the trade name Dimilin. It is a synthetic growth regulator that blocks chitin biosynthesis in arthropods, interfering with the formation and deposition of the endocuticle during molting. When ingested by Lepidopterous insects, such as the gypsy moth, this interference with chitin synthesis causes the body wall of the larva to rupture during the molting phase. Diflubenzuron is effective against the gypsy

moth at very low concentrations, on the order of 0.5 to 1 ounce of active ingredient per acre. Upon ingestion, diflubenzuron is lethal to any stage of gypsy moth larvae.

Diflubenzuron may be applied by ground or aerial application methods to achieve population reduction and foliage protection in light or heavy gypsy moth populations. The insecticide may be used alone or in combination with other intervention components, such as later applications of disparlure.

Fate in the Environment - Diflubenzuron is rapidly degraded in about 3 to 4 days by microbial activity once it gets into the soil. The persistence of diflubenzuron in water is also a function of microbial activity, and is generally short term with a half-life of less than 24 hours (USDA FEIS, 1985; Willcox and Coffey, 1978).

Toxicology - The effects of diflubenzuron on nontarget organisms have been studied by treating several different forest ecosystems with the chemical at rates from 0.5 to 1 ounce active ingredient per acre. Following application, soil microbes and invertebrates, terrestrial and aquatic insects, fish, small mammals, and birds were monitored for any effects from the treatment. No treatment-related effects were observed on soil organisms, terrestrial insects (including honeybees), mammals, or birds (USDA FEIS, 1985; Willcox and Coffey, 1978). Other studies were conducted in aquatic habitats to determine the effect of diflubenzuron on aquatic insects and nontarget crustaceans. Diflubenzuron has been found to reduce populations of certain sensitive nontarget species, such as water fleas, cyclops and immature copepods, mayflies, and diving bugs (USDA FEIS, 1985; Willcox and Coffey, 1978). The overall environmental impact is limited because of the short-lived persistence of the chemical and the recovery of affected populations within 14 to 28 days in most cases (USDA FEIS, 1985; Willcox and Coffey, 1978).

The very low toxicity of diflubenzuron for all organisms other than some insects and arthropods is due to its mode of action of inhibiting chitin synthesis (Willcox and Coffey, 1978). Only organisms that produce chitin will potentially be affected. Mammals, birds, fish, reptiles, and humans are unaffected by diflubenzuron. Diflubenzuron is safe for use around beneficial parasites and predators of the gypsy moth as well as honeybees. Since many beneficial insects are adults at the time of application, they are not affected by diflubenzuron (Willcox and Coffey, 1978). Chitin-producing organisms present in the aquatic ecosystem and in soil during treatment may be affected, but the effects will be temporary because of the rapid degradation of the active ingredient by microorganisms present in both water and soil (Willcox and Coffey, 1978).

Some nontarget molting insects, especially canopy feeding macrolepidoptera and non-lepidopteran mandibulate herbivores insects, may be impacted if this tactic is used. Sucking herbivorous insects, microlepidoptera, and predaceous insects would be less affected (Martinat and others 1988).

Parasites and Predacious Insects

Parasites and invertebrate predators may be introduced into the AIPM Project Area as an intervention tactic using two approaches, classical biological control and augmentation (table II-1.). Classical biological control is the importation and attempted establishment of exotic species. Augmentation is the manipulation of habitat or numbers of established or native species to maximize their effectiveness.

Since most of the established insect predators and parasites will move along with gypsy moth populations that spread into the AIPM Project Area, there may be little

need to augment their numbers in most areas. Some parasites affect only gypsy moth or are gypsy moth specific, while other parasites and predaceous insects affect insects other than gypsy moth (table II-1).

Silvicultural

Research work is currently under way on the development of silvicultural prescriptions that may minimize the impacts caused by the gypsy moth to eastern hardwood forests. Silvicultural prescriptions have been developed for preoutbreak, outbreak and postoutbreak situations. Preoutbreak prescriptions focus on reducing stand susceptibility and vulnerability by increasing stand vigor, removing trees most likely to die, reducing gypsy moth habitat, reducing preferred food sources, improving predator and parasite habitats, and regenerating stands close to maturity. Regeneration cuttings prior to heavy gypsy moth defoliation preserve seed production, establish advanced regeneration, and enhance stump sprouting potential. Outbreak prescriptions are aimed at prioritizing stands for possible insect suppression action and regeneration of those close to maturity or understocked. Postoutbreak recommendations involve the rapid salvage of dead trees, and regeneration of stands that are predicted to incur heavy mortality (K. W. Gottschalk 1987, 1988). Research studies incorporating these prescriptions have been established in hardwood stands in central Pennsylvania and West Virginia to determine their feasibility and effectiveness in reducing or minimizing gypsy moth impacts. Because these studies are ongoing and final results are not available, silvicultural prescriptions will not be incorporated into the alternatives of this EIS. However, several demonstration areas within the AIPM Project Area may be established if research results are favorable.

COMPARISON OF DIFLUBENZURON, *Bacillus Thuringiensis*, NPV EFFECTIVENESS

Diflubenzuron is lethal to gypsy moth larvae of any size. The insecticide must be ingested. Although there is some contact action, insects continue to feed until the next molt before dying. *Bt* and NPV must also be ingested by the gypsy moth larvae, which continue to feed for a short period of time before dying. *Bt* and NPV are much more effective against smaller, younger larvae (first to third instar) than larger, older larvae (fourth instar and beyond).

Diflubenzuron is tightly held on hardwood foliage and residual amounts can be detected on foliage up to 60 days. The effectiveness of *Bt* and NPV from one application is relatively short, 7 to 10 days for *Bt*, slightly less for NPV. However, two applications of NPV are currently applied.

Operational experience in Delaware cooperative suppression projects shows that diflubenzuron generally causes over 90 percent reduction in gypsy moth egg mass densities (Delaware Department of Agriculture 1987, 1988). In these Delaware suppression projects, the egg mass reduction rate with *Bt* was 56 percent in 1987, and the egg mass counts actually increased in the *Bt*-treated areas in 1986. The probability that less than optimum results will occur seems to be greater with *Bt* than for diflubenzuron, probably because of *Bt*'s mode of action and its narrower treatment window (Delaware Department of Agriculture 1987, 1988). No operational data is available for NPV applications.

Table II-1.--Parasitic insects of the gypsy moth

Non-Gypsy Moth Specific Parasites	Gypsy Moth Stage Attacked
Ichneumonidae	
Coccygomimus pedalis	pupa
Itoplectis conquisitor	pupa
Chalcididae	
Brachymeria intermedia	pupa
Tachinidae	
Carcelia amplexa	larva
Compsilura concinnata	larva
Eusisyropa virilis	larva
Exorista larvarum	larva
Exorista mella	larva
Lespesia aletiae	larva
Lespesia frenchii	larva
Nemorilla pyste	larva
Spoggosia claripennis	larva
Tachinomyia supp.	larva
Gypsy Moth Specific Parasites	
Braconidae	
Cotesia melanoscelus	larva
Ichneumonidae	
Phobocampe disparis	larva
Encyrtidae	
Ooencyrtus kuvanae	egg
Eupelmidae	
Anastatus disparis	egg
Tachinidae	
Blepharipa pratensis	larva
Parasetigena silvestris	larva

PRESENTATION OF ALTERNATIVES

Alternatives Considered But Eliminated From Detailed Study

In the process of formulating alternatives, 8 alternatives were considered and later eliminated from further study. All alternatives considered and their associated intervention tactics were evaluated for their ability to meet the primary objectives of the AIPM Project and to address the major issues and concerns as expressed by the public. At this point, the costs of implementing a particular alternative were not a primary consideration.

The following alternatives considered in the analysis were eliminated from detailed study:

1. Parasite and Predator Management Only:

   This alternative involves attempts to actively manage native and introduced parasites and predators of the gypsy moth throughout the Project Area. As new parasites are imported from foreign countries and approved for release in the United States, efforts would be made to establish them in suitable areas. Attempts would be made to redistribute those parasites and predators that are presently established in the generally infested area but not found in the Project Area.

   Reason for elimination. This alternative fails to meet the stated project objectives of minimizing the spread and adverse impacts caused by the gypsy moth. As discussed in Chapter I, Outbreak Cycles and Possible Triggers, parasites and predators exert their greatest impact on the insect during the innocuous mode (low population levels), but are generally ineffective in preventing populations from building to the outbreak mode (high populations) and are incapable of reducing or slowing the spread of the insect into new areas. As the gypsy moth spreads to the South and West, insect parasites that have been established within the generally infested area move along as the gypsy moth extends its range. In some areas where parasites seem to occur in low numbers, attempts may be made to establish them as part of other alternatives.

2. Use of the Inherited Sterility Technique Only:

   This alternative involves the release of sterile life stages of the gypsy moth in infested portions of the Project Area. The Animal and Plant Health Inspection Service (APHIS) has used this technique to eradicate isolated low-level populations in various parts of the United States (USDA FEIS, 1985, Appendix F). Two methods have been used by APHIS:

   a. sterile male technique; this involves the release of sterile male moths that mate with native females to produce eggs that are sterile;

   b. inherited sterility; this involves mating sub-sterilized male moths with normal females in the laboratory.

   Only the inherited sterility technique will be used in the AIPM Project. This is due primarily to the economic and logistical advantages of this method over those of the sterile male technique. As indicated, sub-sterilized males moth are mated with normal females in the laboratory. The egg masses are collected and released into infested areas from the ground

or from the air. The eggs hatch in the spring and the larvae (male and female) feed on the foliage of the area, pupate and emerge as adults. The moths (male and female) mate with the native moths, and the eggs from such matings are sterile and do not hatch the following spring. If sufficient matings occur between the partially sterile and wild female moths, the population is significantly reduced or eliminated from the area the following year.

Reason for elimination. While this alternative has been used successfully by APHIS to eradicate low-level isolated populations, such methods have not proven successful in areas immediately adjacent to or within the generally-infested area of the Northeast, and therefore will not meet the objectives of the project. Additional developmental work is planned on the inherited sterility technique in selected areas of the AIPM project and may eventually become an operational component, but no attempt is planned to rely on such methods solely, unless they prove highly successful in the future.

3. Allow the Moth to Spread Unchecked:

In this alternative, no Federal funds would be spent to suppress the insect on Federal, State or private lands or to implement the AIPM Project. The gypsy moth would be allowed to spread from infested to uninfested areas throughout the proposed AIPM Project area. Insect populations would build to outbreak levels and eventually collapse due to natural causes. No attempt would be made to prevent the insect from defoliating forested areas or to minimize the associated tree mortality.

Reason for elimination: This alternative was not examined in detail because it is unreasonable to assume that the elimination of Federal funds for cooperative State suppression or implementation of the AIPM Project would also prevent State agencies, industrial or private landowners, towns or communities from initiating suppression at their own expense. Such suppression would be aimed at protecting valuable shade and ornamental trees in parks, developed recreation areas, towns and communities as well as high value forest stands. Any EPA-registered insecticide approved for gypsy moth suppression could be used, provided label instructions were followed. In general, suppression efforts would lack an overall coordinated approach between communities, towns or individuals and may involve the use of insecticides that have significant adverse effects on the environment.

4. Use Silvicultural Techniques Only: (See Description of Tactics, Silvicultral)

Reason for elimination: Alone, this does not represent an integrated pest management approach. In addition, use of silvicultural techniques would not meet the objective of reducing or minimizing the rate of spread and damage caused by the gypsy moth in the AIPM Project Area.

5. Use Diflubenzuron Only:

Diflubenzuron would be the only tactic used in the AIPM Project to achieve the goals of minimizing the spread and damage caused by the gypsy moth.

Reason for elimination. The AIPM Project, as the project title suggests, is an integrated pest management demonstration project that will involve an array of intervention components. This alternative does not represent an integrated pest management approach. Annual decisions regarding the

selection of particular intervention tactics to be employed in various parts of the project will be based on site-specific gypsy moth population levels and trends, site and stand information, environmental sensitivity of the area, related biological information and management objectives of the area. Where possible, the least impacting intervention tactic will be utilized to meet project objectives.

Implementation of an alternative where diflubenzuron is the only intervention tactic that could meet the objective of slowing the natural spread and minimizing the damage caused by the gypsy moth. However, this alternative does not encourage the demonstration or operational development of new or existing technologies to meet project objectives.

6. Application of Carbaryl, Acephate, and Trichlorfon:

Carbaryl is a broad spectrum organocarbamate compound that kills insects by both contact action and stomach poisoning. Acephate and trichlorfon are broad spectrum organophosphate compounds used as contact insecticides. All have a cholinesterase-inhibiting mode of action. They may be applied from the ground or by aerial spraying to achieve population reduction in heavy to light gypsy moth populations. Acephate may also be used as a systemic insecticide to protect valuable ornamentals by introducing the chemical into the sap stream of the tree. The insecticide is then translocated to the tree crown, where it kills insects feeding on the foliage.

<u>Reason for elimination</u>: Originally, these insecticides were considered along with diflubenzuron as intervention components in several alternatives in the AIPM Project. However, based on management concerns and public input, it was decided not to include them as viable intervention components. These chemical insecticides are more impacting to nontarget insects, killing insects in all life stages except eggs. Honey bees and aquatic insects are particularly susceptible. Carbaryl and acephate have long residual characteristics. Trichlorfon is no longer produced commercially as a gypsy moth insecticide, and is not available. Although all three chemical insecticides have been approved for use by EPA and addressed in the "Gypsy Moth Suppression and Eradication Projects: Final Environmental Impact Statement, as supplemented, 1985," subsequent State suppression and eradication projects have not included them. Less environmentally-impacting treatments have been used and proven effective.

7. Ground Application of Gypsy Moth-Specific Tactics in Wilderness.

Gypsy moth specific tactics including Gypchek (NPV), Disparlure tape, inherited sterility, mass trapping, and gypsy moth specific parasite release could be used through ground application in wilderness.

<u>Reason for elimination</u>: Ground application requires repeated visits or intensive intrusion into wilderness by AIPM personnel applying these techniques. This would impact wilderness by trampling vegetation, creating undesirable user paths, and installing visible unnatural devices (traps or disparlure tape) that are all incompatible with wilderness management and impacting to the wilderness attributes.

8. Use Gypsy Moth-Specific Tactics Only Over the entire Project Area.

Only gypsy moth specific tactics as discussed in item 7 above could be used in the General Project Area and wilderness. Intervention components could be applied from the ground or air where appropriate in General Project Area, and from the air only in wilderness.

Reason for elimination: The Animal and Plant Health Inspection Service (APHIS) has successfully used the mass trapping tactic alone or in combination with earlier applications of an insecticide to eradicate isolated low-level gypsy moth populations. However, good efficacy data is lacking for this intervention tactic when used in areas adjacent to the generally-infested area of the Northeast. Similar efficacy data is lacking for the use of pheromone flakes or tape alone or in combination in similar areas. NPV normally works best at moderate 250 E.M./acre or higher population levels. However, at low level populations, (less than 100 E.M. per acre) NPV efficacy information is lacking. In addition, the availability of NPV is very limited and further restricts it as a component for use in both the General Project Area and wilderness. The use of the inherited sterility tactic in areas similar to the AIPM Project Area also lacks efficacy data. While the lack of efficacy data for the host-specific tactics prevents developing this into a viable alternative that will meet the objectives of the Project for all areas in the AIPM Project, these techniques are viable when used in conjunction with other intervention tactics. Such combinations are discussed in alternatives considered in detail.

Alternatives Considered In Detail

There are six alternatives considered in detail, including the preferred alternative, (Alternative 5). Alternative 1 represents the no action alternative. Alternatives 2 through 6 would permit the range of options described under each alternative (table II-2).

Since this is an EIS for the AIPM Program, each alternative contains a range of options (including a no action option) that responds to public issues surfaced during scoping. Subsequent site-specific analyses and additional NEPA documentation as needed will be tiered to this document. The site-specific analyses and additional scoping will narrow the issues and analysis area so that one of the options or combination of options, under the selected alternative in this EIS, can be chosen as a course of action. Evaluating intervention action or no action, based on the conditions of the site being considered, will disclose the local potential adverse environmental impacts. It will also provide for the necessary coordination between the landowner or land manager and AIPM personnel to ensure that the proposed courses of action or alternatives are compatible with the management preferences of the landowner or agency policies for the affected area. The site-specific analysis will include:

1. A biological evaluation of the infestation will be completed to determine the probable population trend (building or declining) in the area. This will include an evaluation of site, stand conditions and resources such as: wildlife habitat including endangered, threatened or sensitive plant and animals and their habitat; amount and distribution of gypsy moth susceptible trees and their economic value as well as their value to other resources; visual resources; land ownership and land use in and around the infestation; and topography as it is conducive to spread (ridgetop vs. valley).

2. The development of a range of implementable alternatives to achieve the goals of AIPM, based on the options available under the selected alternative in the Record of Decision for this document and the preferences of private landowners. Implementable alternatives must also comply with the policies and/or management objectives of public land managing agencies.

Scoping identified issues and concerns which were used in developing the alternatives. Therefore, the alternatives vary by the type of intervention tactic permitted and the areas where treatment may occur. Some tactics are permitted by some alternatives, while others are not. Likewise, there are land classes within the Project Area of special concern.

There are 15 Federally legislated wildernesses within the AIPM Project Area. The analysis in Chapter IV, discloses that these areas will be impacted under all alternatives. Part of the management objectives for these areas is to allow natural processes to occur and shape the ecosystem with minimal interference from man. Therefore, if intervention action is taken, the natural processes and wilderness integrity would be affected. On the other hand, if no action is taken, the gypsy moth, an exotic introduced insect, would likewise affect the natural processes and natural integrity. The 1964 Wilderness Act does not provide direction if an exotic insect or disease is introduced into wilderness. Neither does it provide direction on whether such introductions should be considered as part of the natural process or whether these introductions should be prevented or managed to maintain the natural conditions of the areas. This EIS therefore provides information on the potential environmental impacts of both the gypsy moth and intervention activities taken against the gypsy moth (see Chapter IV). This information will aid in the development of alternatives at the site-specific level. It will also provide the decision-maker at the site-specific level with background information so a management strategy can be selected that best complies with the long range wilderness management goals. There may be other lands within the Project Area, including private lands, with similar management objectives that can not be identified in this EIS. The site-specific environmental analysis will identify these areas and similar considerations and modifications to the site-specific alternatives can be made at that time. In order to minimize the impacts of gypsy moth management in wilderness and other special management areas, general criteria have been developed to insure that treatment of gypsy moth infestations is necessary. AIPM personnel will work with affected and interested publics at the project level when treatment of individual wildernesses or special areas is being considered to develop more specific criteria. An evaluation of the gyspy moth population and area where the population occurs will be done by an interdiciplinary team of resource specialists including entomologists, wilderness specialists, and wildlife biologists. Other specialists will be consulted as needed including those from other agencies and individuals from special interest groups. The general criteria or special procedures for infestations in wilderness include:

1. A laboratory examination of egg masses to evaluate (or predict) population viability and probable population size without treatment.

2. An evaluation of the effects on the wilderness attributes if the infestation is allowed to run its natural course.

3. Intensifying forest stand inventory procedures in wilderness to evaluate the hazard and susceptibility of the affected area and surrounding areas to increases in population size and spread from the area.

4. An evaluation of the gypsy moth infestation, which will consider where the infestation is located, whether topographic features are conducive to spread, the amount of susceptible host vegetation inside and outside wilderness and the estimation of potential impacts should an infestation spread from wilderness to adjacent forests.

5. An evaluation of the wilderness infestation in regards to the need to treat to meet AIPM Program objectives and how far removed the wilderness is from established gypsy moth populations.

There is another land class within the AIPM Project Area that requires special consideration. These are forested urban/suburban communities. These areas will require more intensive biological surveys and monitoring than the general forested area to minimize the impacts of gypsy moth. Prior to any intervention action, AIPM personnel will conduct biological surveys to determine the abundance, condition, and distribution of the gypsy moth infestation in the community. This will be part of the site-specific analysis. If AIPM personnel recommend management action, scoping of the interested and affected people in the community will occur to determine the relevant issues associated with managing gypsy moth. Additional NEPA documentation will be prepared as appropriate. A range of site-specific alternatives and mitigating measures to minimize the potential impacts of these alternatives will be developed. The alternatives will reflect public input, management concerns, and the tactics allowed under this EIS's selected alternative. After the site-specific alternatives are developed, they will be distributed to the public for review and comment. Involvement of the people in the community and acceptance by these individuals is essential to an effective IPM program of minimizing the damage and spread of the gypsy moth. Therefore, since the residents of urban/suburban areas and the interested general public will be involved in the site-specific decision regarding management of gypsy moth populations within their community, the range of allowable IPM options under the following alternatives is the same as in the General Project Area. Again, it should be noted that participation in the program is voluntary and that any landowner or land manager can choose not to receive treatment.

The Shenandoah National Park and Blue Ridge Parkway are included in the AIPM Demonstration Project and will participate in the project by having their Congressionally mandated wilderness and lands zoned "natural" by the NPS serve as comparison areas, receiving the same monitoring attention as the remainder of the Project Area and being used to compare the rate of spread and impacts of gypsy moth in untreated areas to treated areas in the remainder of the Project Area. Research on impacts of the gypsy moth on native animal and plant populations in the Park will continue in these areas and some small scale methods improvement evaluations of gypsy moth specific tactics might be conducted as well.

The alternatives are:

<u>Alternative 1</u>. No Action. There would be no AIPM Project as currently planned. The monitoring system, for which there are no impacts, has been put in place using AIPM funding. However, under this alternative, AIPM funding would not be used for intervention activities against the gypsy moth, and the proposed project as planned would not be implemented. However, this does not mean that there would be no action taken against the gypsy moth within the proposed AIPM Project Area. The information gathered by the AIPM monitoring system would be used for cooperative suppression or eradication programs that would take place under the regular gypsy moth suppression program. The potential impacts from these programs are covered under the Final Environmental Impact Statement as Supplemented for Gypsy Moth Suppression and Eradication Projects prepared in 1985 and annual environmental assessments tiered to

that document. Funding for these current programs comes from several sources. The Forest Service administers a cooperative funding program with the States for suppression projects. Eradication projects are administered and cooperatively funded by the Animal and Plant Health Inspection Service (APHIS). There may be other suppression projects within the area using State or private funding and finally, suppression on national forests and other Federal lands may also be implemented.

Alternative 2. In the General Project Area, including forested urban/suburban communities, this alternative would allow treatment using tactics that only affect gypsy moth (gypsy moth specific) and/or biological tactics. No chemical insecticides would be allowed using AIPM funding. Gypsy moth specific tactics include disparlure (tape/flakes), inherited sterility, mass trapping, release of parasites that only affect gypsy moth, and the application of Gypchek (NPV). Biological tactics include the use of Bt and release of parasites and predators.

Wilderness will not be treated. No buffer zones would be necessary adjacent to wilderness under this alternative. Gypsy moth populations within wilderness will be monitored as necessary so treatment outside wilderness can occur to slow the spread of gypsy moth and protect the forest resources surrounding wilderness.

Buffer zones around other no-treatment areas, including individual landowners in urban/suburban areas and the General Project Area who do not wish their land to be treated, will be established as needed. The width of buffer zones will be based on site-specific conditions, including terrain and local weather conditions on the day of treatment, as well as type of treatment being applied and method of application.

Alternative 3. In the General Project Area, this alternative would allow a full IPM approach to managing gypsy moth with treatments as necessary, consisting of the gypsy moth specific tactics and biological tactics described in alternative 2, and with the insect growth regulator, diflubenzuron.

Forested urban/suburban areas could also be treated using the tactics listed for use in the General Project Area. The use of these intervention tactics and any specific mitigating measures will depend on the site-specific analysis and coordination with the local affected residents. Effective alternatives for treatment will be presented to the public, and the selected method of treatment will be determined based on that input and the site-specific analysis.

Wilderness would not be treated. A minimum 200-foot wide buffer zone will be established around wilderness when diflubenzuron is applied from the air in the General Project Area adjacent to wilderness. This buffer zone may be increased due to on-site conditions such as terrain, weather conditions at the time of treatment and the type of aircraft used (See Mitigating Measures, for additional direction when treating adjacent to wilderness). If needed, the buffer zone could be treated with the gypsy moth specific tactics or biological tactics described under alternative 2. Monitoring in wilderness will occur as described in alternative 2.

Buffer zones, as discussed under Alternative 2, will be established as needed.

Alternative 4. In the General Project Area, including the forested urban/suburban areas, this alternative would allow treatment with the same tactics and considerations described under Alternative 3.

In wilderness, only those tactics that specifically affect the gypsy moth and have the least impact to the wilderness will be considered for use. These include aerial applications of disparlure flakes, Gypchek (NPV), and the release of gypsy moth

specific parasites. However, the site-specific analysis must indicate that the intervention action will not have significant adverse impacts to wilderness and is necessary to meet the management objectives of wilderness and the objectives of the AIPM Project.

A minimum 200-foot wide buffer zone will be established around wildernesses when diflubenzuron is applied from the air in the General Project Area adjacent to wilderness. This buffer zone may be increased due to on-site conditions such as terrain, weather conditions at the time of treatment and the type of aircraft used (See Mitigating Measures, for additional direction when treating adjacent to wilderness). If needed, the buffer zone could be treated with the gypsy moth specific tactics or biological tactics. Monitoring in wilderness will occur as described in alternative 2.

Buffer zones, as discussed under Alternative 2, will be established as needed.

Alternative 5. In the General Project Area, including the forested urban/suburban areas, this alternative would allow treatment with the same tactics and considerations described under Alternative 3.

In wilderness, aerial applications of disparlure flakes, Gypchek (NPV) and Bt, as well as the release of gypsy moth specific parasites, may be used. The gypsy moth specific tactics would be considered first because they are less impacting to natural processes (See Chapter IV). However, the site-specific analysis must indicate that the intervention action will not have significant adverse impacts to wilderness and is necessary to meet the management objectives of wilderness and the objectives of the AIPM Project. A minimum 200 foot wide buffer zone will be established around wildernesses when diflubenzuron is applied from the air in the General Project Area adjacent to wilderness. This buffer zone may be increased due to on-site conditions such as terrain, weather conditions at the time of treatment, and the type of aircraft used (See Mitigating Measures, for additional direction when treating adjacent to wilderness). If needed, the buffer zone could be treated with the gypsy moth specific tactics or biological tactics. Monitoring in wilderness will occur as described in alternative 2.

Buffer zones, as discussed under Alternative 2, will be established as needed.

Alternative 6. In the General Project Area, including the forested urban/suburban areas, this alternative would allow treatment with the same tactics and considerations described under Alternative 3.

In wilderness, aerial applications of disparlure flakes, Gypchek (NPV), Bt, and diflubenzuron, as well as the release of gypsy moth host-specific parasites may be used. The gypsy moth specific tactics would be considered for use first. However, the site-specific analysis must indicate that the intervention action will not have significant adverse impacts to wilderness and is necessary to meet the management objectives of wilderness and the objectives of the AIPM Project.

If wilderness is not to be treated, but treatment is planned in the adjacent General Project Area, a minimum 200-foot wide buffer zone will be established around wilderness when diflubenzuron is applied from the air. This buffer zone may be increased due to on-site conditions such as terrain, weather conditions at the time of treatment and the type of aircraft used (See Mitigating Measures, for additional direction when treating adjacent to wilderness). If needed, the buffer zone could be treated with the gypsy moth specific tactics or biological tactics. If treatment is

Table II-2.--AIPM alternatives. Summary of gypsy moth intervention tactics that may be used under each alternative.

ALTERNATIVE	GENERAL PROJECT AREA (includes Federal, State, and private lands other than wilderness)	WILDERNESS
1	NO AIPM PROJECT	NO AIPM PROJECT
2	NO TREATMENT GM SPECIFIC TACTICS BIOLOGICAL TACTICS	NO TREATMENT
3	NO TREATMENT GM SPECIFIC TACTICS BIOLOGICAL TACTICS DIFLUBENZURON	NO TREATMENT
4	NO TREATMENT GM SPECIFIC TACTICS BIOLOGICAL TACTICS DIFLUBENZURON	NO TREATMENT GM SPECIFIC TACTICS*
5	NO TREATMENT GM SPECIFIC TACTICS BIOLOGICAL TACTICS DIFLUBENZURON	NO TREATMENT GM SPECIFIC TACTICS * BIOLOGICAL TACTICS **
6	NO TREATMENT GM SPECIFIC TACTICS BIOLOGICAL TACTICS DIFLUBENZURON	NO TREATMENT GM SPECIFIC TACTICS * BIOLOGICAL TACTICS ** DIFLUBENZURON ***

GM Specific Tactics: Tactics that have been designed to affect gypsy moth specifically. For the General Project Area, this includes Gypchek (NP virus), Disparlaure (tape/flakes), inherited sterility, mass trapping, and gypsy moth specific parasite release.

Biological Tactics: <u>Bacillus</u> <u>thuringiesis</u> (B<u>t</u>), parasites and predators.

* For wilderness, this includes only disparlure flakes and Gypchek (all applied by aerial application only), and gypsy moth host specific parasite release.

** Biological tactics (<u>Bt</u>) will be limited to aerial applications in wilderness and gypsy moth host specific parasite release.

*** Diflubenzuron will be limited to aerial applications in wilderness.

planned in wilderness, the buffer can be treated with the same tactic as that used in wilderness. Monitoring in wilderness will occur as described in alternative 2.

Buffer zones, as discussed under Alternative 2, will be established as needed.

COMPARISON OF ALTERNATIVES

The following discussion compares the alternatives considered in detail as they relate to the issues and environmental consequences disclosed in chapter IV (see table II-3 and II-4.

Alternative 1. The no action alternative means that no AIPM intervention projects will be conducted on State, private, or Federal lands under the AIPM Program. However, the USDA-funded suppression or eradication projects and technical assistance will continue to be available. Isolated infestations would be subject to treatment by regulatory agencies such as APHIS or State regulatory agencies. Action taken by State, municipal, or private individuals to suppress gypsy moth is also possible.

Under the current cooperative cost sharing gypsy moth suppression program, the maximum contribution made by the Federal government is 50 percent of the project cost. It is likely, therefore, that there would be fewer areas treated under this program than under the AIPM Program which will provide 100% funding for the cost of a suppression project. Therefore, it is likely that there would be an increase in losses of timber and shade trees in the AIPM Project Area if the AIPM Program is not implemented.

Isolated infestations that remain untreated within the Project Area would be expected to expand through natural spread of the insect. Depending on the local environmental and physical conditions, the expansion may be rather slow or quite rapid. Untreated populations that build to defoliating levels will result in losses of shrubs, ornamental trees, and timber. Insect nuisance problems will increase.

Alternative 1 does not meet the AIPM objective to slow the spread and minimize the effects of gypsy moth. Existing suppression programs have not proven effective in slowing the natural spread because not all infested areas are treated under these programs.

This alternative is responsive to Major Issue Statement 1 (Impacts to nontarget organisms). Treatment under the AIPM Program would not occur and therefore there would be no impacts to nontarget organisms from this Program. Without any AIPM projects, there is no concern for nontarget impacting tactics. This alternative does not preclude other USDA-funded suppression or eradication projects that may impact nontargets.

In response to Major Issue Statement Statement 2 (Impacts of gypsy moth infestation), without the AIPM Program, spread and the accompanying undesirable impacts of gypsy moth infestations are likely. This alternative addresses public input questioning the need for an AIPM Project.

In response to Major Issue Statement 3 (Impacts to special management areas), the absence of the AIPM Program will have no direct impact to the environment resulting from intervention tactics. However, allowing the moth to run its course may lead to impacts less desirable than those that would accompany treatment.

In wilderness, natural integrity will improve with time. There would be no human manipulation, so change would be made by nature. The apparent naturalness of

wilderness will be impacted, if defoliation caused by this pest becomes readily noticeable. (See Appendix A for a discussion of wilderness attributes).

Depending on the wilderness users' expectations, opportunities for primitive recreation in wilderness may be improved or lowered. In areas of high gypsy moth population, the insect may detract from the wilderness experience as its impacts and could affect the number of visitors to the area. Yet other users may find these factors a physical and mental challenge to overcome. In the long term, the physical and mental challenges within wilderness will change, and there will be a variety of primitive recreation opportunities.

Opportunities for solitude within wilderness will be reduced in the short term, if vegetative screening is reduced by defoliating gypsy moth populations. Different tree species would succeed the tree species favored by gypsy moth. In the long term, opportunities for solitude would return as the ecosystem adjusts to the presence of gypsy moth. Supplemental attributes may be affected. For instance, the number and size of old growth trees of species susceptible to gypsy moth would be reduced.

Scenic values in wilderness would be affected. Large numbers of defoliated trees and associated mortality may occur which would be readily apparent and contrast with natural surroundings. Long-term effects on tree species composition and density would reflect the presence of gypsy moth. In the long term, scenic values will improve as less susceptible tree species become part of the scenic landscape.

Alternative 1 does not respond to issue 4 (effectiveness of intervention tactics) because there would be no attempt to slow the spread of the gypsy moth. A number of public responses expressed a desire to use an efficacious means as possible to slow the spread and minimize the effects of this pest.

There would be no known human health concerns (issue number 5) related to intervention tactics from AIPM Program if the Program is not implemented. Minor human health impacts due to allergic reactions to the gypsy moth may occur. There would be concerns with the current suppression/eradication cooperative projects that could occur under this alternative. However, these issues and concerns are addressed in the existing 1985 EIS (USDA 1985).

Alternative 2. AIPM projects may be planned and implemented on State, private, and Federal lands. Site specific environmental analyses will be prepared by AIPM personnel and managing agencies to determine specific area of treatment, associated environmental impacts, intervention tactics, and mitigation needed to reduce the impacts. AIPM projects will be funded. Action taken by State, municipal, or private individuals to suppress or eradicate gypsy moth may occur independently of the AIPM Program. Although such projects will not receive AIPM funding, it is desirable that managers or owners of these lands cooperate in coordinating these actions with AIPM projects.

This alternative supports the AIPM objective of slowing the spread and minimizing adverse effects of gypsy moth within the Project Area.

In response to Major Issue Statement 1 (Impacts to nontargets organisms), alternative 2 includes tactics that have been developed to specifically affect the gypsy moth. Biological tactics can also be used. These tactics may impact other Lepidopterous insects that are feeding on foliage within the treatment area at the time of treatment. However, the biological tactics are less impacting to nontarget organisms than chemical insecticides.

Alternative 2 is not fully responsive to Major Issue Statement 2 (Impacts of gypsy moth infestations). The tactics included in this alternative will reduce gypsy moth impacts, but they may not be as effective as needed in treating extremely high gypsy moth populations over extensive areas. Gypsy moth infestations will not be treated within wilderness.

In response to Major Issue Statement 3 (Impacts to special management areas), the specific tactic or combination of tactics used in this alternative will consider input from forested urban/suburban communities as well as management requirements of recreation areas, research natural areas, threatened and endangered species habitat, and other special management areas in the site-specific environmental analyses. Impacts due to gypsy moth would be less than alternative 1 because more areas would be treated and the objectives of the AIPM Project are to slow the spread and reduce damage caused by the gypsy moth. The impacts to nontarget organisms from intervention tactics would be less than alternatives 3, 4, 5 and 6 because diflubenzuron would not be used. The effects of no treatment on the wilderness attributes will be the same as discussed under alternative 1.

In response to Major Issue Statement 4 (effectiveness of intervention tactics), alternative 2 provides a range of tactics that should be effective in controlling gypsy moth in the General Project Area. However, gypsy moth-specific tactics and biological tactics may not be as effective in treating extremely high gypsy moth populations.

In response to Major Issue Statement 5 (Impacts to Human Health), there are no human health impacts associated with gypsy moth control tactics proposed. Applications of Bt and NPV are considered to pose no known threat to human health. In over 18 years of operational use, there have been no scientifically documented cases or evidence of Bt-caused illness directly attributable to forestry use situations. Similarly, no documented cases of illness have been attributed to the use of NPV. Minor human health impacts may accompany high gypsy moth infestations in wilderness (Tuthilland others 1984).

Alternative 3. Alternative 3 is the same as alternative 2, except that the chemical insecticide diflubenzuron is added as an intervention tactic in the General Project Area.

This alternative provides a broader range of tactics in an IPM approach to treat all gypsy moth populations as needed in the General Project Area and responds to the AIPM objective of slowing the spread and minimizing adverse effects of gypsy moth.

This alternative responds to Major Issue Statement 1 (Impacts to nontarget organisms) similarly to alternative 2, with gypsy moth specific and biological tactics permitted in the general project area. However, the addition of the chemical insecticide diflubenzuron as an intervention tactic may result in this alternative having additional impacts to nontarget organisms. The use of diflubenzuron may impact molting nontarget arthropods. Adult arthropods will not be affected.

In response to Major Issue Statement 2 (Impacts of gypsy moth infestations), a wider range of intervention tactics available provides greater assurance of control to reduce gypsy moth related impacts in the general project area.

In response to Major Issue Statement 3, (Impacts to Special Management Areas), the effects would be similar to those discussed under alternative 2. In addition, there could be additional impacts due to the use of diflubenzuron. However, if these impacts can be adequately mitigated, this alternative will provide a broader range of

intervention tactics providing a greater opportunity to design treatment for areas with special management considerations.

Wilderness will not be treated. The effects of no treatment on the wilderness attributes will be the same as discussed under alternative 1.

Alternative 3 responds to Major Issue Statement 4 (Effectiveness of intervention tactics). A wider range of intervention tactics that includes diflubenzuron provides a greater assurance of effectiveness in treatment. The use of diflubenzuron in previous suppression and eradication projects has demonstrated its effectiveness in situations of extremely high gypsy moth populations over extensive areas. This alternative provides a greater range of tactics that can protect areas adjacent to no-treatment zones such as wilderness, NPS natural areas, or private land.

Alternative 3 is responsive to Major Issue Statement 5, Impacts to human health. Gypsy moth specific tactics pose no known threat to human health. Since diflubenzuron interrupts chitin synthesis, which does not occur in higher organisms, it poses very low mammalian toxicity. All possible human exposures, as discussed in appendix C, Plain Language Summary of the Health Risk Analysis for Diflubenzuron are below the ADI set by EPA. As in alternatives 1 and 2, minor human health impacts may occur in wilderness due to allergic reactions to the gypsy moth.

Alternative 4. Gypsy moth intervention tactics proposed for the General Project Area for alternative 4 are the same as those in alternative 3. Discussion of the response to the AIPM objectives and Major Issue Statements for alternative 3 is applicable for alternative 4, within the General Project Area.

This alternative differs from alternatives previously compared in that a range of intervention tactics are available for use in wilderness. Alternative 4 effects on wilderness attributes may be different from those described in alternatives 1, 2, and 3 because intervention tactics to suppress gypsy moth in wilderness could occur.

Under alternative 4, the natural integrity in wilderness will be directly affected by gypsy moth intervention techniques if implemented. The existing wilderness environment will reflect human influences rather than biological processes. However, as long as intervention techniques are successful and continued, this alternative will minimize the effects of gypsy moth on the natural succession of the existing wilderness environment. Resulting changes in insect populations will reflect human influence rather than biological forces.

Apparent naturalness within wilderness will be affected if the treatment option is selected. Aircraft and ground support personnel, not normally associated with wilderness, will be present during aerial application of intervention techniques. Intervention techniques, if effective, will help perpetuate the existing wilderness character.

Existing opportunities for primitive recreational experiences will be perpetuated under this alternative if gypsy moth populations are suppressed. A reduction in the number of visitors to wilderness may occur if they object to the treatment types employed.

Physical attributes such as vegetation screening should not be dramatically changed within wilderness under alternative 4. If intervention is selected, aerial application techniques will affect solitude during the period of application.

The impacts to the supplemental attribute of old growth trees from gypsy moth will be reduced under alternative 4 if treatment is done and success in protecting these old growth trees is achieved.

The existing natural scenic qualities of wilderness may be perpetuated under alternative 4 if treatment is taken and successful, although a minor amount of defoliation and mortality may occur.

Alternative 5. Gypsy moth intervention tactics for the General Project Area for alternative 5 are the same as those included in alternatives 3 and 4. Alternative 5 is the same as these alternatives in response to the AIPM objectives and Major Issue Statements for the General Project Area.

Alternative 5 is similar to alternative 4 in treatment of wilderness, although a wider range of intervention tactics is included. Bt may be used in wilderness, in addition to the tactics described in alternative 4. Effects on wilderness attributes for alternative 5 are different than for alternative 4.

Treatment options under alternative 5 will affect natural integrity by the addition of Bt as a possible intervention tactic. This is due to the potential adverse impacts to nontarget native Lepidoptera species.

The effects to the remaining wilderness attributes--apparent naturalness, opportunities for primitive recreation, opportunities for solitude, supplemental attributes, and scenic values--should be similar to those described under alternative 4.

Alternative 6. Gypsy moth intervention tactics for the General Project Area for alternative 6 are the same as those included in alternatives 3, 4 and 5. Alternative 6 is the same as these alternatives in response to the AIPM objectives and Major Issue Statements for the General Project Area.

Alternative 6 is similar to alternatives 4 and 5 in treatment of wilderness, although a wider range of intervention tactics is included. Diflubenzuron may be used in wilderness, in addition to the tactics described in alternatives 4 and 5. Effects on wilderness attributes for alternative 6 are different than for alternatives 4 and 5.

Natural integrity may be affected more under alternative 6 if intervention tactics are employed than under other alternatives. The addition of diflubenzuron as a possible intervention tactic may have additional adverse impacts to insects and crustaceans (Willcox and Coffey 1978).

The remaining attributes - apparent naturalness, opportunities for primitive recreation, opportunities for solitude, supplemental attributes, and scenic values should be similar to those described under alternatives 4 and 5.

Table II-3.--Comparison of alternatives by major issues.

Major Issues	Alternative(s)	Summary
Issue Statement 1 (Impacts of treatment to nontargets)	1	No AIPM tactics proposed to impact non-targets. Co-op program may impact non-targets.
	2	No impacts from gypsy moth-specific tactics. Biological tactics may impact other Lepidoptera.
	3-6	No impacts from gypsy moth-specific tactics. Biological tactics may impact other Lepidoptera; diflubenzuron may impact some arthropods.
Issue Statement 2 (Impacts of Gypsy Moth)	1	Gypsy moth impacts possible in non-treated areas.
	2-3	Gypsy moth impacts reduced in General Project Area but not in wilderness.
	4	Gypsy moth impacts reduced in General Project Area and in wilderness.
	5	Gypsy moth impacts reduced in General Project Area and further reduced in wilderness.
	6	Gypsy moth impacts reduced throughout Project Area.
Issue Statement 3 (Impacts on Special Management Areas)	1	Gypsy moth impacts possible in non-treated areas. No impacts from suppression funded by AIPM.
	2	Gypsy moth impacts reduced in General Project Area, but not in wilderness. Tactic impacts less than under alternatives 3,4,5 and 6.
	3	Gypsy moth impacts reduced in General Project Area, but not in wilderness. Tactic impacts may occur.
	4	Gypsy moth impacts reduced in General Project Area, reduced in wilderness. Tactic impacts may occur. Impacts to wilderness less than alternatives 5 and 6.
	5	Gypsy moth impacts minimized in General Project Area, reduced in wilderness. Tactic impacts may occur. Impacts to wilderness less than under alternative 6.

Table II-3.--Comparison of alternatives by major issues (continued).

	6	Gypsy moth impacts minimized. Tactic impacts may occur.
Issue Statement 4 (Effectiveness of Intervention Tactics)	1	No AIPM-funded intervention tactics.
	2	In General Project Area, provide a limited range of tactics. Application limited by population levels and/or insect life stages. Wilderness not applicable.
	3	In General Project Area, broader range of tactics. Application less limited by population levels or insect life stages. Wilderness not applicable.
	4	In General Project Area, same as alternative 3. In wilderness, limited range of tactics. Application limited by population levels and/or by insect life stages.
	5	In General Project Area, same as alternative 3. In wilderness, range of tactics less limited than under alternative 4. Application less limited by insect population levels and/or by insect life stages.
	6	Broader range of tactics. Application less limited over Project Area than other alternatives.
Issue Statement 5 (Impacts on Human Health)	1	Sensitive individuals may experience minor gypsy moth-related allergic reactions; none due to AIPM-funded tactics.
	2	No scientific data indicating human health problems associated with the tactics.
	3	No scientific data indicating human health problems associated with gypsy moth specific or biological tactics. Risk assessment (Appendix C) indicates potential effects to human health from the use of diflubenzuron to be extremely low. All human exposure estimates are below established ADI.
	4	Same as alternative 3.
	5	Same as alternative 3.
	6	Same as alternative 3.

The environmental consequences of each alternative considered in detail are discussed in Chapter IV. A summary of the environmental consequences follows in table II-4.

Table II-4.--Summary of environmental consequences in the AIPM Project Area.

Environmental Elements	Alternative(s)	Summary
Vegetation	1	Significant defoliation possible with associated tree mortality; long term change in cover type may result. Wildfire control may be more difficult if significant gypsy moth caused mortality occurs.
	2-6	With the exception of the inherited sterility tactic, there are no direct, indirect or cumulative impacts to vegetation from intervention tactics. There may be short-term direct effects from the inherited sterility tactic. In wilderness, the potential impacts similar to alternative 1 are possible under alternatives 2 and 3. There would be no impacts to vegetation in wilderness under alternatives 4, 5 and 6.
Wildlife (vertebrates except fish)	1	No known direct effects. Indirect effects include temporary changes in habitat, and some food supplies and shifts in some populations as well as possible long term changes in habitat diversity, food variety and numbers or abundance of animals. Cumulative effects of repeated gypsy moth defoliations would amplify long term effects.
	2	Reduction of effects caused by gypsy moth possible except in wilderness. No known direct effects. Indirect effects consist of short-term reductions of some food supplies for some insect eaters in treated areas. Cumulative effects of repeated treatments consist of extended duration of indirect effects.
	3	Reduction of effects caused by gypsy moth possible except in wilderness. No known direct effects. Indirect and cumulative effects similar to effects of alternative 2, except populations of insects susceptible to diflubenzuron will be unavailable as a food source for a longer period of time in treated areas. Cumulative effects of repeated treatments consist of extended duration of indirect effects.
	4	Reduction of effects caused by gypsy moth possible throughout project area. Direct, indirect and cumulative effects are identical to those for alternative 3 in General Project Area. Direct, indirect and cumulative effects in wilderness are associated with reductions of gypsy moth as a food source in treated areas.

Table II-4.--Summary of environmental consequences in the AIPM Project Area (continued).

	5	Reduction of effects of gypsy moth possible throughout project area. Direct, indirect and cumulative effects identical to those for alternatives 3 and 4 in general project area. In wilderness, direct, indirect and cumulative effects would be similar to those found in alternative 2 (General Project Area).
	6	Reductions of effects of gypsy moth possible throughout project area. Direct, indirect and cumulative effects similar to those described for general project area in alternative 3.
Insects, snails and crustaceans	1	No direct effects. Indirect effects would be gypsy moth competes with leaf-eating insects for food and habitat.
	2	No known direct impact due to gypsy moth specific tactics. Bt may directly impact nontarget lepidoptera. This effect may be cumulative if two Bt applications are made per year or in consecutive years. There could be a beneficial effects by reducing the impacts of gypsy moth.
	3-6	For alternatives 3-6, same as alternative 2; diflubenzuron may directly impact some nontarget arthropods. The potential exists for these impacts to be cumulative if applications of diflubenzuron are made in consecutive years. In wilderness, effects similar to those described under alternative 1 could occur under alternative 2 and 3. There could be beneficial effects by reducing the impacts of gypsy moth.
Endangered, Threatened and Sensitive Species (E,T&S)	1	There are no known direct effects. There may be adverse indirect effects if defoliation alters habitats. Some species may benefit if tree mortality occurs. In areas containing untreated outbreak of gypsy moth populations, the potential exists for direct impact to E&T plants.
	2	Existing habitats would benefit with successful treatments. Bt may have a direct adverse impact on nontarget E,T&S Lepidoptera larvae that feed on foliage within 7-10 days of application. There may be cumulative effects on these species if two applications are applied per year or in consecutive years. E,T&S plants could benefit if treatment maintains low gypsy moth populations.

Table II-4.--Summary of environmental consequences in the AIPM Project Area (continued).

	3-6	In addition to effects of Bt in alternative 2, diflubenzuron may have a direct impact on some nontarget E,T or S arthropods. These effects may persist if applications are applied in consecutive years. Existing habitats would benefit with successful treatment. In wilderness, effects similar to those described under alternative 1 could occur under alternative 2 and 3.
Fish & Aquatic Ecosystems	1	No direct effect from AIPM-funded activities. Direct beneficial effect if gypsy moth larvae provide additional food. Indirect beneficial effect if water nutrient content is increased due to gypsy moth feeding activity.
	2	There are no known adverse effects of gypsy moth specific or biological tactics. Effects of gypsy moth would be reduced.
	3-6	No direct effects on fish. Limited potential for some aquatic arthropod populations to be reduced temporarily following treatments with diflubenzuron. In wilderness, effects similar to those described under alternative 1 could occur under alternative 2 and 3.
Soil	1	Defoliation speeds nutrient transfer to soil.
	2-6	For alternatives 2-6, no known direct, indirect or cumulative impacts. In wilderness, effects similar to those described under alternative 1 could occur under alternative 2 and 3.
Water Quality	1	Possible short term effect on odor, taste and color in defoliated areas.
	2-6	In General Project Area, there are no known direct, indirect or cumulative effects. In wilderness, effects similar to those described under alternative 1 could occur under alternative 2 and 3. There are no known direct, indirect or cumulative effects under alternatives 4, 5 and 6.

Table II-4.--Summary of environmental consequences in the AIPM Project Area (continued).

Visual Resources	1	Direct short-term effects to aesthetics in defoliated and refoliated areas.
	2-6	In General Project Area, no known adverse effects. Intervention tactics should reduce gypsy moth impacts on the visual resource. In wilderness, effects similar to those described under alternative 1 could occur under alternatives 2 and 3. There are no known adverse effects under alternatives 4, 5 and 6.
Recreation	1	Direct short-term impact on use of developed recreation sites during treatment application or if severe defoliation occurs because of no treatment. Effect on use may be long-term if mortality of high value trees occurs. Recreational experience in dispersed areas could be affected.
	2-6	Impacts of gypsy moth to developed and dispersed recreation areas should be reduced. Use may decline during time of treatment or avoided following treatment. Use would be affected for short periods if areas are temporarily closed during time of treatment. Intervention methods should reduce direct, indirect and cumulative methods of gypsy moth.
Cultural Resources	1-6	No impacts anticipated.
Public Health	1	Sensitive individuals may experience minimal gypsy moth-related allergic reactions.
	2-6	No scientific data indicating human health problems associated with gypsy moth-specific or biological tactics. Risk assessment (Appendix C) indicates potential effects to human health from use of diflubenzuron to be extremely low. All human exposure estimates are below established ADI.
Socio-Economic	1	If gypsy moth tree mortality causes timber supply to exceed demand, local timber market prices may decrease.
	2-6	Intervention tactics should reduce gypsy moth-caused tree mortality, which would benefit timber--an important economic resource in the Project Area. Intervention would help reduce gypsy moth-caused fluctuations of timber supply to local markets.
Prime Farm and Rangeland	1-6	For alternatives 1-6, no impacts anticipated.

Table II-4.--Summary of environmental consequences in the AIPM Project Area (continued).

Wetlands and Flood plains	1-6	For alternatives 1-6, no impacts anticipated.
Consumers, Civil Rights, Minorities and Women	1-6	For alternatives 1-6, no impacts anticipated.
WILDERNESS ATTRIBUTES:		
Natural Integrity	1-3	Direct impacts to natural processes by gypsy moth. Long term impacts produce changes in the existing ecosystem. Indirect and cumulative effects will show natural processes adapting to gypsy moth.
	4	Direct impacts to natural processes by gypsy moth in no-treatment areas. Long-term impacts produce changes in existing ecosystem from no treatment. Indirect and cumulative effects will show natural processes adapting to gypsy moth in no-treatment areas. Direct impacts by gypsy moth-specific tactics will reflect human intervention, but existing ecosystems will be perpetuated if these tactics are successful and are continually applied when needed. Long term effects will reflect a continual need for human intervention in the control of gypsy moth.
	5	Impacts from no treatment and gypsy moth-specific tactic are the same as in alternative 4. Additional direct impacts to natural processes will occur as the use of Bt reduces the population size of susceptible, nontarget Lepidoptera in treatment zones present at the time of application. Cumulative impacts may occur as those susceptible nontarget Lepidoptera in treatment zones are reduced in population size in consecutive years of spray applications. A continual need for human intervention in the control of gypsy moth will be required.
	6	Impacts from no treatment, gypsy moth-specific tactics and the application of Bt are the same as in alternative 5. Additional direct impacts to natural processes will occur, as the use of diflubenzuron will adversely affect some nontarget invertebrate organisms. Diflubenzuron will reduce or eliminate these susceptible organisms if present in the treatment zone at the time of application. Cumulative impacts to these susceptible organisms may occur (further reduction in population size or total elimination) in the treatment zones if diflubenzuron is used in succeeding years. A

Table II-4.--Summary of environmental consequences in the AIPM Project Area (continued).

		continual need for human intervention will be required for the control of gypsy moth.
Apparent Naturalness	1-3	Direct impacts to the wilderness ecosystem would be readily noticeable to the general public when compared to treated areas. Associated defoliation and tree mortality in susceptible wilderness would contrast with pre-gypsy moth wilderness environment. Indirect effects from changes in the natural processes caused by gypsy moth could affect biological diversity of the areas, resulting in an environment that contrasts with areas located outside wilderness.
	4-6	Intervention techniques maintain existing naturalness of the area. Direct impacts would be from AIPM personnel and equipment in the area at the time of application. Cumulative impacts would be limited to repeated use of intervention techniques when necessary to manage gypsy moth in wilderness.
Primitive Recreation Opportunity	1-3	Direct impacts to recreational experiences through tree defoliation and mortality by gypsy moth. Primitive conditions created by tree mortality, subsequent new plant growth and changes in the wilderness ecosystem would allow for a high degree of challenge and risk. Nuisance factors created by high populations of gypsy moth larvae may detract from the expected wilderness experience. Long term effects of gypsy moth infestation would provide a change in the existing physical and mental challenges and the variety of primitive recreational opportunities as the wilderness ecosystem adjusts to the presence of gypsy moth.
	4-6	Existing opportunities for primitive types of recreational experiences are maintained. Changes in the types of opportunities and experiences proceed as a natural process.
Opportunity for Solitude	1-3	Direct short-term impact as existing foliage used as screening is defoliated. Long-term impacts in the form of new vegetative growth replacing gypsy moth-caused mortality, thus increasing opportunities for solitude as the ecosystem adjusts to gypsy moth.
	4-6	Existing vegetative screening maintained, thus preserving opportunities for solitude. Short-term adverse impact in that opportunities for solitude are reduced in the form of increased contact between wilderness users and AIPM personnel. Cumulative impacts in the form of frequent and continual need

Table II-4.--Summary of environmental consequences in the AIPM Project Area (continued).

		to enter wilderness for gypsy moth activities reduce overall opportunities for solitude.
Supplemental Attributes	1-3	Direct impact to old growth trees through defoliation and subsequent trees mortality. Value of the area to serve as a baseline for natural process studies is preserved. Effects to endangered, threatened and sensitive species are similar to those outlined in the General Project Area under alternative 1.
	4-6	Old growth trees are protected from effects of gypsy moth. Value of wilderness to serve as a baseline for natural processes is lost. Effects to endangered, threatened and sensitive species are similar to those outlined in the General Project Area.
Scenic Values	1-3	Direct impacts to the visual resource through tree defoliation and mortality. Minimal long-term impacts as less susceptible gypsy moth species replace those species lost to gypsy moth-caused mortality. Different species composition and density will add variety to the landscape qualities of form, line, color and texture.
	4-6	Direct impacts to the visual resource as existing scenic values are maintained. A continual need for intervention activities to maintain existing scenic values.

MITIGATING MEASURES

As indicated in Chapter I, this EIS is not site specific. Additional site-specific analysis and NEPA documentation as appropriate will be conducted and tiered to this document. The site-specific analysis will be developed by the appropriate land managing agency, based primarily upon gypsy moth population data management objectives, on-site conditions and public input. A detailed biological evaluation of gypsy moth infestations will be a component of this analysis. Potential treatment sites within the AIPM Project Area would, depending upon the alternative selected in this EIS, include most susceptible forests, parks, recreation areas and forested urban/suburban areas. These sites could range in size from a few to several hundred acres, or more.

The development of mitigating measures will vary, depending upon the intervention tactic(s) employed, application methods used, sensitivity of the Project Area and related site or stand characteristics. These site-specific mitigation measures and their anticipated effectiveness will be identified during the site-specific analysis.

In general, it is desirable to use the least impacting intervention technique available in the selected alternative that is capable of achieving project objectives.

The following mitigation measures are applicable and required when the proposed treatment area contains endangered and threatened species:

Endangered and Threatened Species

Requirements and measures for activities affecting endangered, threatened, or proposed species are detailed in species recovery plans and in FSH 2609.23R. Recovery plans have been prepared for the American Peregrine Falcon, Bald Eagle, Indiana Bat, Virginia Big-eared Bat, Flat-spired, Three-toothed Land Snail, Pink Mucket Pearly Mussel, and Tubercled Blossom Pearly Mussel.

A recovery plan is in preparation for the Virginia Northern Flying Squirrel. Chapters in FSH 2609.23R have been prepared for Bald Eagle.

This section lists those mitigating measures to be incorporated in developing AIPM demonstration project area plans when populations of endangered, threatened, proposed or category 1 species (USDI F&WS; 50 CFR, Part 17) are encountered (see table III-3).

Virginia Northern Flying Squirrel

An estimation of habitat (mature spruce, fir or mixed hardwood/spruce/fir forest) susceptibility to gypsy moth defoliation and site-specific determination of effects of defoliation on habitat quality will be done in coordination with the US Fish & Wildlife Service and the appropriate State wildlife agency. This coordinated effort will be initiated for populations in (1) the Stuart Knob area (Randolph County), (2) the Cheat Bridge area (Pocahontas and Randolph Counties), (3) the Cranberry area (Pocahontas and Greenbriar Counties) and, (4) the Spruce Knob area (Pendleton County) in West Virginia and; in Virginia, the Laural Fork area (Highland County). Any adverse effects of a no-treatment prescription will be evaluated at the project level. Based on existing scientific evidence, site-specific guidelines established at the project level should eliminate the potential for adverse effects on Virginia northern flying squirrel habitat.

Virginia Big-eared Bat, Indiana Bat

Estimations of effects of gypsy moth defoliation on foraging habitat and native populations of night-flying insects (primarily Lepidopterans) will be made in coordination with the US Fish & Wildlife Service and the appropriate State wildlife agency. Determination of acceptable locations and/or an acceptable ratio of treated (Bt or diflubenzuron) area to foraging area will also be made in coordination with the US Fish & Wildlife Service and the appropriate State agency. These coordinated efforts will be initiated for known colony sites in Randolph, Hardy, Pendleton, Grant, and Tucker counties in West Virginia and Highland, Bath and Shenandoah counties in Virginia.

Any adverse effects of a no-treatment prescription, or application of Bt or diflubenzuron, will be evaluated at the project level (based on existing scientific evidence). Site-specific guidelines established at the project level should eliminate the potential for adverse effects on food supplies for Virginia Big-eared Bat and the Indiana Bat.

Bald Eagle

1. Aerial flights associated with AIPM projects will not be permitted within 1/4 mile horizontal distance and 500 feet vertical distance of an active nest.

2. Human entry during courtship, nest building, incubation or brooding periods will not be permitted within 1/4 mile horizontal distance of an active nest except under one of the following conditions (the US Fish & Wildlife Service and appropriate State wildlife agency shall be consulted in determining if any of these conditions exist):

   a. A reduction of a bald eagle nest management zone is permissible when a pair of bald eagles is determined to be tolerant of closer human activity. New limits will be established in consultation with the US Fish & Wildlife Service and appropriate State wildlife agencies.

   b. Research or management activities essential for the protection or continued survival of a bald eagle pair and their habitat must be implemented.

   c. Topography or other characteristics of a nest site indicate an extension or reduction of a bald eagle nest management area.

Disturbance of active eagle nest sites during nest building, egg laying, incubation and brooding may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity (including aircraft operation) near a nest late in the nesting cycle may cause premature fledging, lessening the chance of survival.

Restricting human activity associated with the AIPM Project in bald eagle nest management areas should eliminate the potential for adverse effects from the AIPM Program.

Peregrine Falcon

Protect nest sites (aeries) by restricting human activity within management zones established in coordination with the US Fish & Wildlife Service and the appropriate State wildlife agency. Site-specific guidelines designed by responsible officials should eliminate the potential for adverse effects from the AIPM Program.

Cheat Mountain Salamander, Shenandoah Salamander

An estimation of habitat (forested areas above 3100 feet) susceptibility to gypsy moth defoliation and site-specific determinations of effect of defoliation on habitat quality will be done in coordination with the US Fish & Wildlife Service and the appropriate State wildlife agency. This coordinated effort will be initiated for the area from McGowan Mountain extending to the north rim of the Blackwater River canyon, east to Dolly Sods, south to Spruce Knob, southwest to Thorny Flat and north through Barton Knob to McGowan Mountain in West Virginia and for known populations of Shenandoah Salamander in Virginia. Any adverse effects of no-treatment prescription will be evaluated at the project level. Based on scientific evidence, site-specific guidelines established at the project level should eliminate the potential for adverse effects on habitat for these salamanders.

Flat-Spired, Three-Toothed Land Snail

Although little is known about the effects of chemical insecticides, or physiology or ecology of this snail, given what is known, diflubenzuron will not be available for gypsy moth control in the Cheat River Gorge of Mongalia County in West Virginia. The limited habitat (approximately 2.5 square kilometers in size) and low but unknown population size dictate extreme caution when introducing chemical agents. Known populations of the flat-spired, three-toothed land snail will not be subjected to applications of diflubenzuron.

Madison Cave Isopod

An estimation of effects on water quality resulting from gypsy moth defoliation above sites with known populations will be done in coordination with the US Fish & Wildlife Service and the appropriate State wildlife agency. In addition, diflubenzuron will not be available for gypsy moth control in the groundwater recharge area for Madison's Saltpetre Cave and Steger's Fissure in Virginia (portions of Augusta and Rockingham counties). Limited habitat and relatively small population size dictate extreme caution when introducing chemical agents. Known populations of Madison Cave isopod will not be subjected to diflubenzuron. Site-specific guidelines should eliminate the potential for adverse effects on water quality and food supplies for the isopod.

Plants (Swamp Pink, Running Buffalo Clover, Shale Barren Rockcress, Harparella)

An estimation of habitat susceptibility to gypsy moth defoliation and site-specific determination of effects of defoliation on habitat quality and site conditions will be done in coordination with the US Fish & Wildlife Service and the appropriate State wildlife agency. This coordinated effort will be initiated for populations of swamp pink in Augusta and Nelson counties (Virginia); populations of running buffalo clover in Fayette and Webster counties (West Virginia) and known populations of shale barren rockcress and harparella in the AIPM Project Area.

A determination of population response to defoliation of individual plants by gypsy moth will be based on site-specific information. Recommendations to protect

populations of these plants will be made at the project level in coordination with the US Fish & Wildlife Service and the appropriate State wildlife agency. Any potential adverse effects of a no treatment prescription should be eliminated.

In areas where endangered or threatened (ET) plant species have been identified, ground-application tactics will avoid sites known to contain ET plants.

Ground-applied intervention tactics require intensive application procedures, maintenance and follow up to check the adequacy of the intervention tactic. The frequency of entry to these areas by AIPM personnel could have detrimental effects on these plant species from trampling or other ground disturbances. Restricting ground application intervention tactics on sites harboring ET plants should eliminate the potential for any adverse effects.

Sensitive Species

Biological evaluations (FSM 2672.4) will be conducted as part of the site-specific analysis for known populations of sensitive species (see table III-4). Based on scientific evidence, guidelines developed at the project level should eliminate the potential for adverse effects on populations, habitat or food supplies of sensitive species from the AIPM Program.
The following general mitigating measures apply to all alternatives that contain insecticides (NPV, Bt or diflubenzuron) intervention tactics:

1. Microbial (NPV and Bt) and chemical (diflubenzuron) insecticides will be applied following label directions.

   This ensures that appropriate precautions are taken to minimize human exposure to insecticides during mixing and loading operations; that insecticide applications are made under the supervision of a qualified applicator having EPA recognized certification; and that appropriate equipment is used to deliver the insecticides at recommended rates, at the proper stage of insect development, to maximize insecticide efficiency. In addition, label directions for diflubenzuron require that no direct applications will be made over open bodies of water or wetlands and that efforts are made to mitigate drift out of the target areas. Finally, it ensures that insecticides are properly stored and that empty containers are disposed of in the required manner which mitigates human exposure and environmental contamination.

2. Insecticides will be applied when the following meterological conditions are present in the target area. This will mitigate insecticide drift, maximize deposition on target foliage and reduce run-off of the material.

   a. Wind speed in the target area cannot exceed 10 miles per hour.

   b. Application will be halted when air temperatures exceed 70 degrees Fahrenheit or when inversion conditions develop that would prevent insecticide deposition in the target area.

   c. Application will be suspended when the chance of rain is greater than 50 per cent. After rain, application will resume only when target foliage has dried.

3. All treatment areas will be delineated on USGS topographic maps which show forest cover, elevation contours, bodies of water, major streams and man-made structures such as roads, buildings and power lines.

   a. Treatment areas will be delineated on the maps in a manner that takes advantage of natural landmarks and facilitates treatment. Additional marking will be provided in the field by placement of helium filled balloons or other visible markers placed at strategic points.

   b. Buffer strips, inside or adjacent to treatment areas, will be delineated on maps and marked in the field as necessary, with balloons or other visible markers of different colors from markers used to delineate treatment areas.

   c. Maps showing various treatment blocks, buffers and exclusion areas will be provided to applicators for their review at least one day prior to application operations. Applicators will be briefed each day prior to the initiation of treatment operations.

   d. Forest Service, Park Service or State personnel will monitor from the air or ground all applications. Radio equipment for air-to-air and air-to-ground communications is required.

   e. Ground crews will be present for on site monitoring of insecticide deposition and drift detection monitoring during application.

   f. Application of insecticides or other materials will be confined to daylight hours, when other meterological and related conditions are favorable.

These application requirements will ensure that insecticides or other materials are applied to the intended areas, at appropriate times and under conditions that are as safe as possible. Additional criteria or requirements as may be needed will be incorporated into Project Work and Safety Plans.

4. Private property owners or managers that do not wish to have their land treated with insecticides will be excluded from the Project on request.

   In order to minimize unwanted insecticide exposure to humans, animals and property, objectors may request to exclude their property from such treatment. Exclusion from treatment should directly minimize insecticide exposure.

5. Buffer zones around no-treatment areas, including those of individual land owners in urban/suburban areas of the General Project Area who do not wish their land to be treated, will be established as needed.

   Size of buffer zones will be based on site conditions as well as the type of treatment being applied and method of application. Potential of drift onto nontarget locations will be minimized under this measure and should prevent unwanted exposure to Project objector's property.

6. Treatment of developed recreation areas (picnic areas and campgrounds) will be scheduled for low-use periods or will be temporarily closed during treatment. Such areas will be signed at least 24 hours prior to treatment operations.

Scheduling treatment of recreation areas on low-use periods or the temporarily closure of areas will minimize human exposure to treatments. Signs posted in advance of treatment will provide information on scheduled treatment dates and type of treatment, providing the user with the opportunity to avoid or minimize exposure to treatments.

7. For application of diflubenzuron, all water bodies and streams which are not canopy-covered will have a buffer zone of 200 feet. The buffer zone will either not receive treatment or receive a single or double application of Bt or Gypchek. This will mitigate against the adverse effects of diflubenzuron upon aquatic organisms.

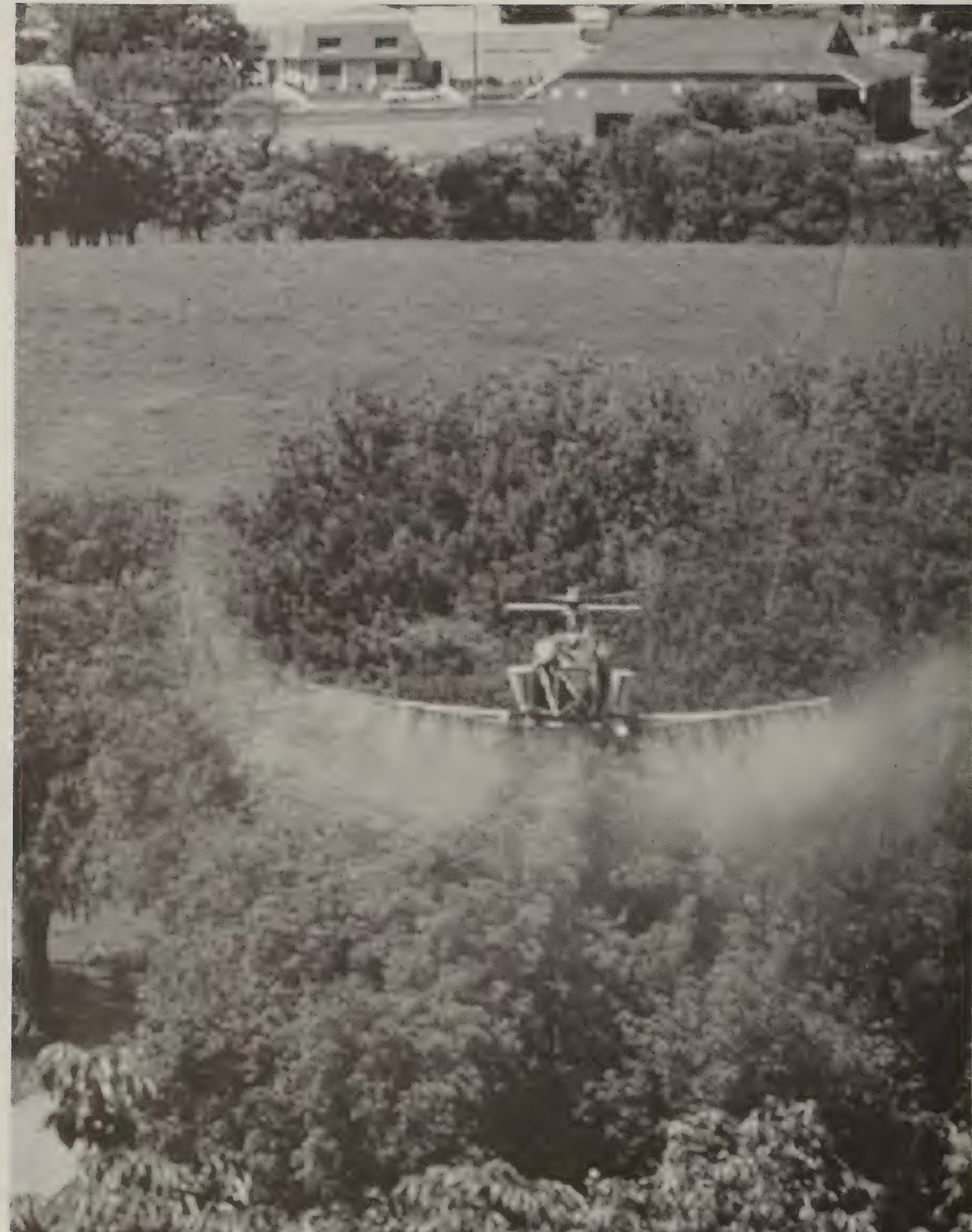
8. Aerial applications of intervention tactics for wilderness will be signed outside wilderness at major entry points prior to treatment. Intervention tactics in the treatment of insect pests are not expected in wilderness. As such, wilderness users may object to intervention while present in the area or after treatment. Signing of the area at major trailheads will inform users of the type of aerial intervention tactics to be applied and time span in which application may occur thus allowing the user to minimize or avoid exposure to the tactic. Wilderness will be signed at least one week prior to treatment.

9. Insecticides, to be effective are applied as small (200 micron) droplets. As such, some drift off site is likely to occur. Drift of diflubenzuron will impact wilderness attributes should it drift into Wilderness. To minimize these impacts, a 200 foot buffer zone adjacent to and outside of Wilderness will be established. This buffer zone may be increased due to on-site conditions. The establishment of a buffer zone will serve to minimize effects caused by drift.

Additional mitigation measures will be developed in the site-specific NEPA documents that are applicable to the Project Area and intervention techniques proposed. These measures will be aimed at minimizing human exposure and environmental impacts from the insecticides applied.

AFFECTED ENVIRONMENT

CHAPTER III



CHAPTER III

AFFECTED ENVIRONMENT

INTRODUCTION

This chapter describes present environmental conditions of the Project Area that may be affected by the alternatives. Environmental conditions are broadly grouped into these categories: Geology, Soils, Wetlands and Floodplains, Climate and Air Quality, Water, Vegetation, Wildlife and Wildlife Habitat, Fish and Aquatic Ecosystem, Threatened, Endangered or Sensitive Species, Visual Resource, Social and Economic Factors, Prime Farmland and Rangeland, Recreation and Cultural Resources. A more specific category, Wilderness, provides greater detail for parts of the environment for which there are specific management concerns in relation to the alternatives considered.

LOCATION

The Project Area straddles the Appalachian Mountains, south of the West Virginia/Pennsylvania border (figure I-1). It covers 12.8 million acres in all or portions of 18 counties of Virginia, and 20 counties of West Virginia (table III-1). Within the area are the George Washington, Jefferson, and the Monongahela National Forests, Shenandoah National Park, and Blue Ridge Parkway. The project involves privately owned and managed lands, and municipal, county, and State lands in addition to lands managed by Federal agencies.

This area was defined as the Project Area because it is generally limited in an east-west direction by the Appalachian Mountains. Also, male gypsy moth and egg-mass survey data were available so boundaries could be established. In reviewing this data, it was found that at least 50 percent of the area would contain gypsy moth populations which have the potential for increasing to defoliating levels within 3-5 years.

The southern boundary was established where male moths were no longer caught in State/Federal standard grid pheromone traps. Counties were included within the northern boundary to ensure that insect populations would be managed to reduce subsequent population pressures on the remainder of the area. Throughout the Project Area, forest types susceptible to the gypsy moth are present and continuous. These factors will permit AIPM personnel to determine forest impacts and the evaluation of applicable management practices.

PHYSICAL AND BIOLOGICAL SETTING

Geology, Soils, Wetlands and Floodplains

The Project Area lies within the Appalachian Physiographic Region, which is subdivided into physiographic provinces based on rock type and structure. The Blue Ridge, Ridge and Valley, and Appalachian Plateau Physiographic Provinces are within the Project Area.

The Blue Ridge Province contains mainly metamorphic and igneous rocks. These rocks are part of the Eastern Overthrust Belt which overlays the sedimentary rocks of the Ridge and Valley Province to the West. The area is characterized by broad ridges with low peaks, which are the result of differences in the weathering of various rocks. Mountain slopes are generally stony and steep.

The Ridge and Valley Province is heavily folded and faulted. The soils are derived from sedimentary rocks. Most residual soils are moderately deep and well drained, and have a fine, loamy texture. They are weakly structured and slightly erosive, with the exception of limestone-derived soils, which are well structured and highly erosive.

Table III-1.--AIPM Project Area counties

COUNTY	ACRES WITHIN PROJECT AREA
West Virginia	
Barbour	218,200
Fayette	424,300
Grant	305,900
Greenbrier	656,700
Hardy	374,400
Harrison	267,500
Marion	199,000
Mercer	266,800
Monongalia	233,500
Monroe	302,500
Nicholas	416,000
Pendleton	444,800
Pocahontas	603,500
Preston	412,800
Randolph	663,000
Taylor	111,400
Summers	223,800
Tucker	269,500
Upshur	225,300
Webster	352,600
SUBTOTAL	6,971,500
Virginia	
Albermarle	470,800
Alleghany	290,300
Amherst	306,200
Augusta	643,100
Bath	343,700
Bedford	482,600
Botetourt	348,500
Craig	211,100
Greene	100,400
Highland	266,100
Madison	205,900
Nelson	303,600
Page	200,300
Rappahannock	171,000
Roanoke	197,500
Rockbridge	389,400
Rockingham	557,400
Shenandoah	327,800
SUBTOTAL	5,815,700
TOTAL	12,787,200

The Appalachian Plateau Province is nearly horizontal rock strata. This province is characterized by broad, flat-topped ridges and narrow, V-shaped valleys. Soils of this province are similar to those of the Ridge and Valley Province. Some soils are derived from sandstones and shales and are deeper to bedrock. Colluvial soils are common.

There are wetlands and floodplains within the Project Area. Some fresh water wetlands can be found throughout the AIPM Project Area in Virginia and West Virginia. Wetlands, as referred to in this document, are defined (by Executive Order 11990) as: areas that are inundated by surface or ground water with frequency sufficient to support, and that under normal circumstances do or would support, a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Some 100-year flood plains occur in the AIPM Project. Flood plain, as used in this document, is defined (by Executive Order 11988), as: low land and relatively flat areas adjoining inland and coastal waters, including flood-prone areas of off-shore islands, including at a minimum that area subject to a 1 percent or greater chance of flooding in any given year.

Climate and Air Quality

The climate, characteristically humid continental, is influenced by the mountain ridges. Precipitation varies across the Project Area from a low of 30 inches to a high of over 60 inches annually. Precipitation is well distributed throughout the year and occurs in the higher elevations on an average of 240 days per year. The average annual temperature is 45°F. Depending on elevation, aspect, and other site conditions, the growing season ranges from 140 to more than 200 days.

Water

The Project Area, lying astride the Eastern Continental Divide, is drained by the Ohio, James and Potomac river systems. Numerous rivers and streams flow within the Project Area, providing fish and wildlife habitat, recreation, agricultural, industrial, and municipal water supplies.

Vegetation

The Project Area contains heavily forested ridges with wooded areas in the intervening agricultural valleys. Forested areas within the Project Area range from remote Federally designated wilderness to forested residential lands. Timber stands are generally less than 90 years old, as a result of the widespread harvest that occurred in the early 1900's. Two major vegetation types, beech-birch-maple and oak-hickory dominate the area. White pine occurs on the lower slopes, and yellow pine occurs on the south and southwest slopes in the eastern portion of the Project Area.

Within the Project Area, the climate and physiography of the Appalachian Region support three major fuel types with differing burning characteristics. Burning characteristics of each fuel type depend upon a number of factors, such as weather (wind speed and direction, relative humidity, precipitation, temperature and atmospheric stability), topography (steepness of slope, aspect, and elevation), and fuels (moisture content, arrangement, compactness, size and shape, continuity and chemistry). The peak periods of fire occurrence are generally in the spring and fall, when

there is an abundance of fuel and low moisture content. Periodic droughts can either extend the fire seasons or initiate them earlier than normal. The primary cause of wildfires in the area are arson and debris burning. The major fuel types are:

1. Hardwoods and mixed hardwood-conifer types. This is the predominant forest cover type of the area and is best represented by oak-hickory stands. It can also include northern and mixed forest types. The fuel is primarily hardwood leaf litter and supports low fuel loads and low to high intensity surface fires.

2. Conifers and mixed conifer-hardwood types. This fuel type consists of an overstory of pine (white, pitch, table mountain and Virginia), spruce, fir, and hemlock. Hardwoods of various species may be present in the overstory, in the understory, or in both. Available fuels include hardwood leaf litter, needles, shrubs, and decaying woody material. The fuel load will support low to moderate-intensity surface fires, but in areas where downed material is concentrated, an intense fire can occur.

3. Logging slash associated with harvest cuts or heavy thinnings. This can include both hardwood and conifer stands. Fuels can include all material that has been cut down within the area. Intense fires can be expected if the slash is heavy, concentrated, and dry.

Wildlife and Wildlife Habitat

Appalachian Mountain ecosystems support a great variety of terrestrial and aquatic animal life. This variety reflects the wide range of climatic conditions, elevation, forest types, and successional stages in the Project Area. Wildlife species commonly found within the Project Area are listed in table III-2.

Fish and Aquatic Ecosystem

Coldwater and warmwater fisheries occur throughout the Project Area. Coldwater ponds and streams support populations of native brook trout. Both Virginia and West Virginia supplement this coldwater fishery with active put-and-take trout programs stocking rainbow, brown, and brook trout. Warmwater fisheries, the larger streams, rivers, lakes and ponds support smallmouth bass, largemouth bass, walleye pike, panfish, and catfish. Many nongame fish and other aquatic species are found within the Project Area.

Endangered, Threatened or Sensitive Species

The USDI Fish & Wildlife Service recognizes several plants and animals found in the Project Area as threatened or endangered (50 CFR 17.11, 17.12); (see table III-3 and Appendix B). The Virginia Commission of Game & Inland Fisheries, West Virginia Department of Natural Resources, USDI Fish & Wildlife Service and the USDA Forest Service have also identified several species found in the Project Area as sensitive (see table III-4).

Table III-2.--Wildlife species commonly found within the Project Area

Common Name	Scientific Name
White-tailed deer	*Odocoileus virginianus*
Eastern wild turkey	*Meleagris gallopavo*
Black Bear	*Ursus americanus*
Bobwhite quail	*Colinus virginianus*
Eastern mourning dove	*Zenaida macroura*
Cottontail rabbit	*Sylvilagus floridanus*
Gray squirrel	*Sciurus carolinensis*
Fox squirrel	*Sciurus niger*
Ruffed grouse	*Bonasa umbellus*
American woodcock	*Scolopax minor*
Racoon	*Procyon lotor*
Mink	*Mustela vison*
Muskrat	*Ondatra zibethicus*
Gray fox	*Urocyon cinereoargenteus*
Red fox	*Vulpes fulva*
Bobcat	*Lynx rufus*

Thousands of other species of birds, mammals, reptiles, amphibians, and invertebrates also live in or near the Project Area.

Visual Resource

The Appalachian Mountains, Blue Ridge Mountains, and the Shenandoah Valley are renowned for their scenic beauty. Vast, diverse forested areas maintain a near-natural appearance, with man-made elements adding to the diversity of the landscape. The traveler sees spectacular and inspiring views from the Blue Ridge Parkway, Skyline Drive, interstate highways and other roadways as well as from the Appalachian Trail and other hiking trails. The most important factor in this visual resource is that of mountainous landforms, steep slopes and narrow winding valleys laced with mountain streams. Conspicuous rock forms and vegetative diversity provide a rewarding experience to the visitor.

Social and Economic Factors

Within the Project Area are small private holdings, particularly at lower elevations and in the forested lands between mountain ridges. Large forested acreages exist within the Project Area under Federal management. These include the Monongahela, Jefferson and George Washington National Forests and the Shenandoah National Park. Other forested areas are managed by private corporations, private nonindustrial landowners, the States of Virginia and West Virginia, and other Federal agencies.

Prime Farmland and Rangeland

Land use within the Project Area is primarily agriculture and forest oriented. Areas dominated by agriculture use contain crop and pasture land; dairy, beef and

Table III-3.--Federally endangered, threatened or proposed species known to occur within the Project Area

COMMON NAME	SCIENTIFIC NAME	*STATUS
Mammals		
Squirrel, Virginia N. Flying	Glaucomys sabrinus fuscus	E
Bat, Virginia Big-eared	Plecotus townsendii virginianus	E
Bat, Indiana	Myotis sodalis	E
Birds		
Falcon, American Peregrine	Falco peregrinus anatum	E
Eagle, Bald	Haliaeetus leucocephalus	E
Amphibians		
Salamander, Cheat Mountain	Plethodon nettingi	PT
Salamander, Shenandoah	Plethodon shenandoah	PE
Fish		
Logperch, Roanoke	Percina rex	PE
Snails		
Snail, Flat-spired Three-toothed Land	Triodopsis platysayoides	T
Clams		
Mussel, James River Spiny	Pleurobema (Canthyria) collina	E
Mussel, Tuberculed Blossom Pearly	Epioblasma t. torulosa	E
Mussel, Pine Mucket Pearly	Lampsilis Orbiculata	E
Crustaceans		
Isopod, Madison Cave	Antrolana lira	T
Insects		
none		
Plants		
Swamp Pink	Helonias bullata	T
Running Buffalo Clover	Trifolium stoloniferum	E
Shale Barren Rockcress	Arabis serotina	C1
Harparella	Ptilimnium Nodosum	PE

*Federal status from USDI Fish & Wildlife Service as of August 1988.

E - endangered
T - threatened
PE - proposed endangered
PT - proposed threatened
C1 - Information is available to support proposal to list

Table III-4.--State, Forest Service or U.S. Fish and Wildlife Service sensitive species within the Project Area not Federally listed or proposed.

COMMON NAME	SCIENTIFIC NAME	SOURCE*
Mammals		
Hare, Snowshoe	*Lepus americanus virginianus*	1
Shrew, Pygmy	*Sorex hoyi* (includes *S. thompsoni*)	1,5
Weasel, Least	*Mustela nivalis*	1
Shrew, Southeastern	*Sorex longirostris*	1
Shrew, Long-tailed	*Sorex dispar*	1,5
Shrew, Water	*Sorex palustris*	1,5
Cottontail Rabbit, New England	*Sylvilagus transitionalis*	1,5
Myotis, Keen's	*Myotis septentrionalis*	4
Bat, Small-footed	*Myotis leibii*	4,5
Bat, Rafinesque's Big-eared	*Plecotus rafinesquii*	5
Mole, Star-nosed	*Condylura cristata*	5
Woodrat, Eastern	*Neotoma floridana*	5
Vole, Rock	*Microtus chrotorrhinus*	5
Birds		
Heron, Great Blue (rookeries only)	*Ardea heroides*	4
Hawk, Coopers	*Accipiter cooperii*	1
Eagle, Golden	*Aquila chrysaetos*	1
Flycatcher, Alder	*Empidonax alnorum*	1
Wren, Bewick's	*Thryomanes bewickii*	4,5
Shrike, Loggerhead	*Lanius ludovicianus*	4,5
Sparrow, Bachman's	*Aimophila aestivalis*	5
Reptiles		
Turtle, Bog	*Clemmys muhlenbergi*	1
Turtle, Map	*Graptemys geographica*	1
Snake, Northern Pine	*Pituophis m. melanaleucus*	1
Rattlesnake, Timber	*Crotalus horridus*	5
Amphibians		
Hellbender	*Cryptobranchus alleganiensis*	5
Salamander, Green	*Aneidas aeneus*	1,5
Salamander, Spring	*Gyrinophilus porphyriticus*	5
Salamander, Pygmy	*Desmognathus wrighti*	1
Salamander, Shovelnose	*Leurognathus marmoratus*	1
Salamander, Thunder Ridge	*Plethodon nettingi hubrichti*	1
Salamander, Cow Knob	*Plethodon punctatus*	1,5
Salamander, Yonahlossee	*Plethodon yonahlossee*	1
Fish		
Sculpin, Bluestone	*Cottus sp.*	5
Darter, Sharphead	*Etheostoma acuticeps*	1
Darter, Tippecanoe	*Etheostoma tippecanoe*	1
Shiner, Roughheaded	*Notropis semoeraspger*	1

Table III-4.--State, Forest Service or U.S. Fish and Wildlife Service sensitive species within the Project Area not Federally listed or proposed (continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE*
Madtom, Orange-Fin	Noturus gilberti	1
Logperch, Blotchside	Percina burtoni	1
Dace, Redside	Clinostomus elongatus	4
Shiner, Popeye	Notropis ariommus	4
Minnow, Kanawha	Phenacobius teretulus	4,5
Minnow, Cheat	Rhinichthys bowseri	4,5
Darter, Finescale Saddled	Etheostoma osburni	4,5
Darter, Longhead	Percina macrocephala	4,5
Insects		
Mayfly, West Virginia burrowing	Ephemera triplex	5
Dragonfly, Alleghany snaketail	Ophiogomphus incurvatus alleghen.	5
Beetle, Ground	Sphaeroderus schaumi ssp.	1
Beetle, Six-banded Longhorn	Dryobius ocxnetatus	5
Beetle, Maureen's Minute Moss	Hydraena maureenae	5
Beetle, American Burying	Nicrophorus americanus	5
Beetle, Black Rove	Lordithon niger	5
Moth, Marbled Underwing	Catocala marmota	5
Moth, Precious Underwing	Catocala pretiosa	5
Moth, Hebard's Nocutid	Erythroecia hebardi	5
Butterfly, Tawny Cresent	Phyciodes batesi	5
Butterfly, Regal Fritillary	Speyeria idalia	1,5
Moth, Chestnut Clearwing	Synanthedon castaneae	5
Crustaceans		
	Apochthonius paucispinosus	3
Crayfish, New River Riffle	Cambarus chasmodactylus	5
	Cambarus nerterius	3
	Caecidotea cannulus	4
	Caecidotea siminni	4,3
	Caecidotea sinuncus	4,3
	Chitrella regina	3
	Colias interior	3
	Fontigens holsingeri	4,3
Cavesnail, Organ	Fontigens tartarea	4,3
	Fontigens turritella	3
	Islandiana speophila	3
	Kleptochthonius orpheus	3
	Kleptochthonius hetricki	3
	Kleptochthonius henroti	3
	Plusiocampa sp 1	3
	Pseudanophthalmus hadenoecus	4,3
	Pseudanophthalmus montanus	4
	Pseudanophthalmus subequalis	3
	Pseudanophthalmus p. potomaca	3
	Pseudanophthalmus potomaca senecae	3
	Pseudanophthalmus krekeleria	3
	Pseudanophthalmus lallemanti	3

Table III-4.--State, Forest Service or U.S. Fish and Wildlife Service sensitive species within the Project Area not Federally listed or proposed (continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE*
	Pseudosinella certa	4,3
Millipede, Greenbriar Valley Cave	Pseudotremia fulgida	4,3
	Pseudotremia lusciosa	4,3
	Pseudotremia princeps	4,3
	Sphalloplana culveri	4,3
Isopod, Burnsville Cove cave	Stygobromus conradi	5
Isopod, Morrison's Cave	Stygobromus morrisoni	3,5
Amphipod, Bath County Cave	Stygobromus mundus	2,5
	Stygobromus redactus	3
	Stygobromus allegheniensis	3
Amphipod, Minute Cave	Stygobromus parvus	4,3
	Stygobromus nanus	4,3
	Trichopetaium krekeleri	4,3
Plants		
White Monkshood	Aconitum reclinatum	4
Wild Onion	Allium oxyphilum	4,5
Pirate Bush	Buckleya distichophylla	1,2
Reed Grass	Calamagrostis porteri	4
Variable Sedge	Carex polymorpha	4,2,5
Grape-Stemmed Leather-Flower	Clematis viticaulis	1
Dwarf Dogwood	Cornus canadensis	1
Fraser's Sedge	Cymophyllus fraseri	1
Showy Lady's Slipper	Cypripedium reginae	1
Umbrella Leaf	Diphylleia cymosa	1
Spotted or Nodding Mandarin	Disporum maculatum	1
Woodland Horsetail	Equisetum sylvaticum	1
Yellow Buckwheat	Eriogonum alleni	4
Darlington's Purge	Euphorbia purpurea	4,2,5
Virginia Sneezewood	Helenium virginicum	1,2
Swamp Pink	Helonias bullata	1
White Alumroot	Heuchera alba	1
Long-stalked Holly	Ilex collina	1,5
Large-spored Quillwort	Isoetes macrospora	1
Gray's Lily	Lilium grayi	1
Highland Rush	Juncus trifidus ssp.	4
Fir Clubmoss	Lycopodium selago	1
Barbara's Buttons	Marshallia grandiflora	4,5
Interrupted Royal Fern	Osmunda ruggii	1
Canby's Mountain Lover	Pachistima canbyi	4,5
Ginseng	Panax quinquefolium	1
Mainden Cane Panic	Panicum hemitomon	1
Sworleaf Phlox	Phlox buckleyi	4
Jacob's Ladder	Polemonium vanbruntie	4,6
Three-toothed Cinquefoil	Potentilla tridentata	1
Roan Mountain Rattlesnake-root	Prenanthes roanensis	1
Gray's Saxifrage	Saxifraga caroliniana	5
Northeastern Bulrush	Scirpus ancistrochaetus	1,2

Table III-4.--State, Forest Service or U.S. Fish and Wildlife Service sensitive species within the Project Area not Federally listed or proposed (continued).

COMMON NAME	SCIENTIFIC NAME	SOURCE*
Hearted-leaved Skullcap	*Soutellaria ovata pseudoarguta*	5
Virginia Spirea	*Spiraea virginiana*	4
Mountain Pimpernell	*Taenida montana*	5
Steele's Meadow-rue	*Thalictrum steeleanum*	2,5
Kate's Mountain Clover	*Trifolium virginicum*	1,5
Dwarf Trillium	*Trillium pusillum*	1,5
Large Cranberry	*Vaccinium macrocarpon*	1
Turkey Beard	*Xerophyllum asphodeloides*	1

*Where sensitive species status, originated from:

Code

1 - USDA Forest Service (R-8)
2 - Virginia Commission of Game & Inland Fisheries
3 - West Virginia Department of Natural Resources
4 - Proposed USDA Forest Service (R-9)
5 - USDI Fish & Wildlife Service

horse farms; sheep, poultry and other small animal production; and other agricultural activities. Abandoned and working orchards are scattered throughout the Project Area.

Employment in the lumber and wood products industry has increased over the past 20 years, and efforts to enhance this industry and associated employment have been taken by both states. In addition to agriculture and forestry, much of the economy has been dependent on energy resources and development. When energy production and development decline, decreases in associated manufacturing fields within the Project Area will also decline.

Recreation

Recreation has become an important part of the economic picture. Within the Project Area, a wide spectrum of recreational opportunities is available to much of the Mid-Atlantic area. One-fifth of the nation's population is located within a day's drive of the area. Recreational opportunities are being provided by the public and private sectors. Dispersed recreational activities such as fishing, hunting, hiking, canoeing, bird watching, primitive camping, and horseback riding are being provided primarily by the three National Forests (Monongahela, Jefferson, and George Washington) and Shenandoah National Park (with the exception of hunting in the park). Developed recreational sites on Federal lands provide numerous opportunities for activities such as family camping, picnicking, swimming, and boating. Interpretation services and commercial facilities are provided by public and private sectors. Caverns, ski areas, developed RV parks, historic sites, lodges and restaurants are but a few examples of attractions provided by the private sector. Tourism is being actively promoted within the area by local and State governments as well as by private sectors and is becoming a major source of revenue. Projected

recreation demand figures show a rising trend for all types of recreational facilities (Commonwealth of Virginia 1984).

Typical of the Appalachian Region, this area is abundant in natural resources, but has historically lagged behind surrounding areas in economic growth. Recognizing this situation, Congress passed the Appalachian Regional Development Act of 1965. Per capita income is considerably less than the national average.

Parts of the area are rural residential land. Many people are moving in from urban areas, and second-home development is increasing. Long-term residents are more likely than newcomers to think of the forested areas as a source of employment. This is particularly true in the more rural portions of the Project Area, where unemployment tends to be high.

The Project Area is interspersed with small communities. Larger municipalities within the Project Area include Morgantown, Fairmont, Grafton, Bridgeport, Clarksburg, Salem, Buchannon, Elkins, Fayetteville, Oak Hill, Princeton, and Bluefield, West Virginia. The larger Virginia municipalities within the Project Area are Luray, Harrisonburg, Staunton, Waynesboro, Charlottesville, Lexington, Buena Vista, Bedford, and Roanoke.

Cultural Resources

Evidence indicates that human occupation of lands within the AIPM Project Area began at least 12,000 years ago (USDA, George Washington National Forest FEIS, 1986, USDA, Jefferson National Forest FEIS, 1985, USDA, Monongahela National Forest FEIS, 1985). Prehistoric cultural remains have been documented from the Paleo-Indian, Archaic, Woodland, and Protohistoric Periods.

European exploration of the Region began in the second half of the seventeenth century and settlement of the area began in the early to mid-eighteenth century. The historic period includes activities related to lumbering, mining and farming. Numerous historic site types are found throughout the area and include cabins, farmsteads, mines, graves, Civil War sites, iron furnaces and CCC camps.

WILDERNESS

The AIPM Project Area includes 15 wildernesses. Included with the wildernesses is Shenandoah National Park's "Natural Area" zone (81,257 acres) which, for the purposes of this EIS, will be considered and discussed as a wilderness. The total acreage of wilderness and "natural area" is approximately 270,615 acres, or 2 percent of the total Project Area (only 4,025 acres of the Mountain Lake Wilderness is included due to project boundaries). (See table III-5 and figure III-1).

Based on the Wilderness Act's definition of wilderness, the Forest Service describes the four attributes of wilderness as: (1) natural integrity; (2) apparent naturalness; (3) outstanding opportunities for solitude; and (4) opportunities for primitive recreation. The Forest Service describes two additional attributes. One is a supplemental attribute composed of outstanding ecological, geological, and historical features. The other attribute is the scenic values contributed by the natural features of the area. They are supplemental because they may be present, but they are not required by the Wilderness Act.

Each wilderness attribute evaluation is based on specific criteria. For example, natural integrity is based on impacts of human activity in each area. Solitude is based on factors such as screening by trees or other plants and the evidence of man's

presence. Boulders or other landforms also provide acceptable screening, as does size of area. See Appendix A for discussion of attributes of each wilderness.

Natural Integrity

Natural integrity is the extent to which long-term ecological processes are intact and operating. This attribute describes the extent to which human influences have altered natural processes. The present state of the area is compared with conditions which have no visible human impacts. This attribute is based on how man's influences, such as vegetation manipulation, have altered natural conditions. With time, these altered conditions will not be evident to most people.

Vegetative manipulation can include timber harvesting and forest management treatments such as hardwood control. Fire history includes signs of fire used to control hardwoods, snakes, and ticks.

Apparent Naturalness

Apparent naturalness is closely related to natural integrity. Both qualities are altered by the same activities. Apparent naturalness focuses on how the general public perceives the activities. The term includes "natural" aspects that are seen, heard, or smelled.

Outstanding Opportunities for Solitude

Solitude is isolation from sights, sounds, and the presence of others. The developments and evidence of man do not appear. Features that contribute to solitude are size of area and distance from perimeter to center. Vegetation and topographic screening are also related to solitude.

Opportunities for Primitive Recreation

Primitive recreation provides opportunities for isolation from the evidence of man. A vastness of scale exists in most of these areas. Visitors feel they are a part of the natural environment. They may enjoy a high degree of challenge and risk and use of outdoor skills. One meets nature on its own terms, without comfort or convenience facilities.

Supplemental Wilderness Attributes

The Wilderness Act states that an area may also contain special ecological and geological features. Other scientific, educational, scenic, or historical features may also be present.

Ecological Features. This attribute includes threatened or endangered species of animals and plants and old growth trees. Other special ecological features may also exist.

Special Geological Features. This attribute offers landforms that represent significant examples of geological processes.

Cultural and Historical Features. These resources comprise all evidence of historic and prehistoric human use of an area. They include petroglyphs and pictographs (ancient carvings on rocks). Trails as well as historic sites may exemplify the development of an area. Examples include pioneer homesteads, evidence of early logging or mining, and trade or military routes.

Scenic Values

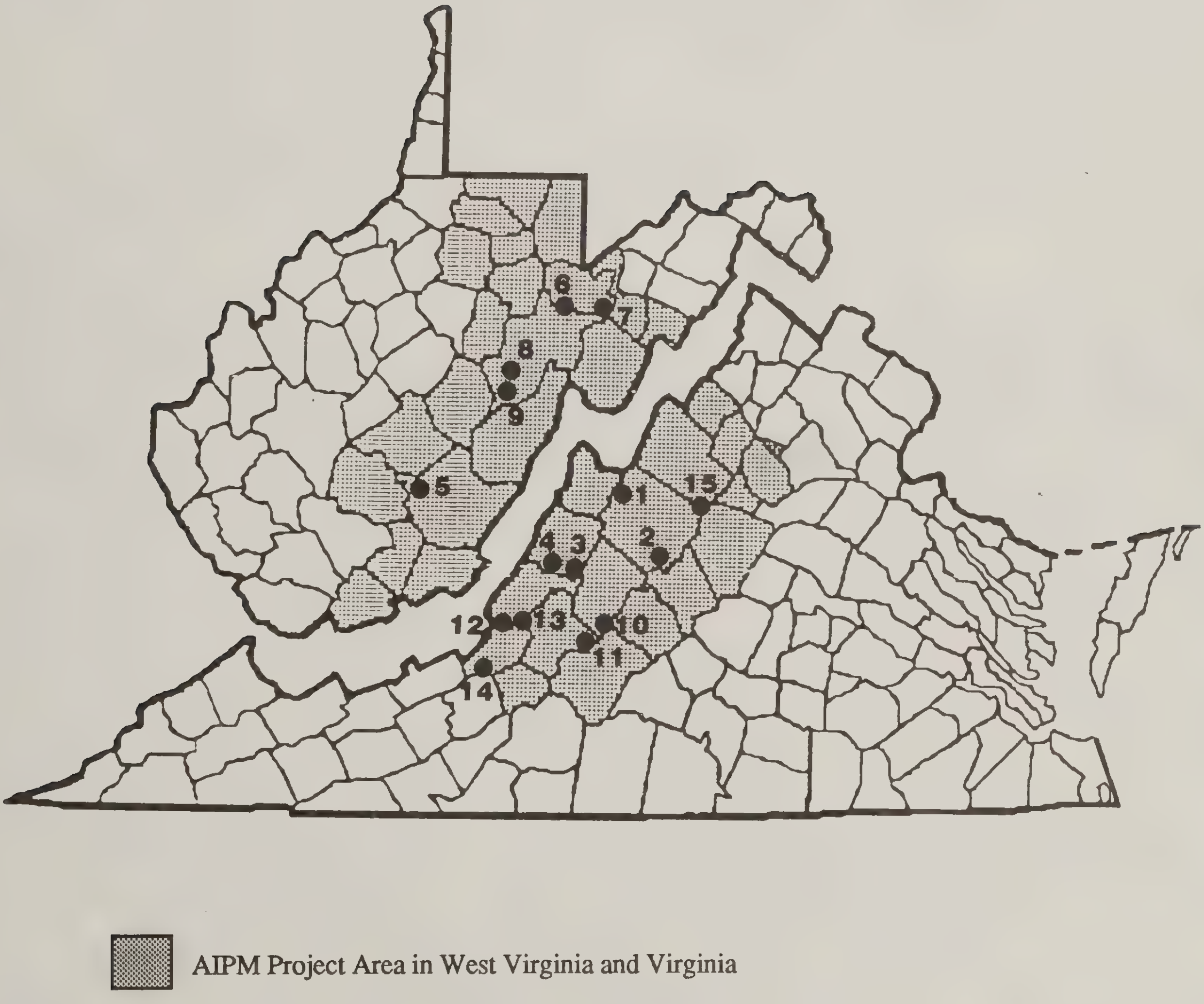
Scenic values are based on significant visual qualities of the natural landscape in the wilderness. Natural features that contribute to the scenic qualities are land forms, rock forms, plants, and water (lakes and streams). The unique qualities of these natural features depend on how unusual, outstanding, and uncommon they are.

The characteristic landscape in wilderness is in ecological succession and should be accepted as such. Although it may be a beautiful landscape now, it can change because of catastrophic events such as fire, storms, and insects or diseases. Natural ecological processes create the diversity in flora and fauna desirable in wilderness. Visual quality and scientific value are by-products achieved under the landscape management objectives of preservation.

Table III-5.--Wilderness and natural zones with AIPM Project Area

WILDERNESSES		ACRES
George Washington National Forest		
Ramseys Draft		6,725
St. Marys		10,090
Rich Hole		6,450
Rough Mountain		9,300
Monongahela National Forest		
Cranberry		35,864
Otter Creek		20,000
Dolly Sods		10,215
Laurel Fork North		6,055
Laurel Fork South		5,997
Jefferson National Forest		
James River Face		8,903
Thunder Ridge		2,450
Shawvers Run		3,665
Barbours Creek		5,700
Mountain Lake		4,025
Shenandoah National Park		
Shenandoah		53,919
Shenandoah Natural Zone		81,257
	TOTAL	270,615

AIPM Project Area
In West Virginia and Virginia



WILDERNESSES:

1. Ramseys Draft
2. St. Marys
3. Rich Hole
4. Rough Mountain
5. Cranberry
6. Otter Creek
7. Dolly Sods
8. Laurel Fork North
9. Laurel Fork South
10. James River Face
11. Thunder Ridge
12. Shawvers Run
13. Barbours Creek
14. Mountain Lake
15. Shenandoah

Figure III-1.–This Project Area includes 15 wildernesses in West Virginia and Virginia.

ENVIRONMENTAL CONSEQUENCES

CHAPTER IV

ENVIRONMENTAL CONSEQUENCES

Page

INTRODUCTION

This chapter discusses the potential environmental consequences of each alternative considered in detail on the environment within the AIPM Project Area. The information may be used to compare the alternatives using the existing conditions (alternative 1, no action) as a baseline. A summary of the environmental consequences by alternatives is contained in Chapter II (table II-4). The analysis was derived from the environmental conditions presented in Chapter III and from resource data, research findings and related information.

The alternatives were analyzed to determine the potential effects on the following environmental elements:

- vegetation
- insects
- fish and aquatic ecosystems
- water quality
- visual resource
- cultural and historical resources
- socio-economic effects
- wetlands and flood plains
- wilderness
- wildlife and wildlife habitat
- endangered, threatened and sensitive species
- soil
- air quality
- recreation
- public health
- prime farmland and rangeland
- consumers, civil rights, minority groups and women

The estimated direct, indirect and cumulative effects of the alternatives are discussed. Direct effects are those caused by the action and occur at approximately the same time and place. Indirect effects are also caused by the action, but occur later in time or farther removed in distance, but are still reasonably foreseeable Cumulative effects develop from repeated use of an action or intervention component on the resource when added to other past, present, and reasonably foreseeable future actions. These effects may build up over time and throughout a given area.

ALTERNATIVE I (No Action)

Alternative 1 represents the no action alternative required by CEQ regulations. The intervention phase of the AIPM Demonstration Project would not be implemented. Funding for AIPM would not continue or be limited to monitoring only. State/Federal cooperative gypsy moth suppression and eradication programs would continue as needed on State and private lands in Virginia and West Virginia. These cooperative programs are funded with up to 50 percent Federal funds and 50 percent State and local funds (county or city). Similarly, normal suppression on National Forest lands and National Park lands could also be implemented as gypsy moth populations build to defoliating levels within the area of the proposed project. These projects would be Federally funded. The short-term objectives of such suppression would be to prevent excessive defoliation and tree mortality, and to reduce insect populations in selected high-value, suburban/urban areas and high-use recreation areas. Environmental impacts of this suppression are covered in the 1985 Gypsy Moth Suppression and Eradication Projects Final Environmental Impact Statement, as Supplemented. Annual site-specific environmental analysis would further consider the expected environmental impacts of the annual projects in detail. Although action could be taken by State and Federal agencies to suppress heavy populations in selected high value areas, most of the infested areas would not be treated, and the natural spread of the insect throughout the proposed project area would continue unabated. At the most southern portions of the proposed AIPM project area, isolated infestations could be treated as a cooperative State/Federal eradication project.

State or private areas that would not be treated under normal State/Federal suppression projects would be those areas that do not meet State criteria. These criteria are generally based on gypsy moth population levels, resource values, or residential or recreation values at risk. Regardless of values, areas having light populations are not generally treated under normal suppression.

Forest landowners, depending upon their management objectives, may decide to suppress potentially damaging gypsy moth populations at their own expense to prevent excessive tree mortality. Others may decide to implement silvicultural treatments as described in Chapter II (Gottschalk 1987).

Suppression on National Forest land is subject to similar criteria and must comply with Forest Land and Resource Management Plans (LRMP), objectives, and policy. Suppression action would be aimed at protecting those areas having high resource values and heavy gypsy moth population levels. Areas that would be excluded from suppression would be low value forest stands or areas with light gypsy moth populations. Threatened or endangered species habitat areas and other sensitive areas would not be treated unless gypsy moth threatened destruction of sensitive habitat and treatment could be sufficiently mitigated. Thus, under alternative 1, much of the State, Federal, and private land in the proposed AIPM project would not receive treatment, and the natural spread of the insect would not be slowed.

Vegetation

Under this alternative, the gypsy moth would be allowed to infest and become a permanent component of the ecosystem in forested areas where no suppression action would be taken by State or Federal agencies. In areas that would not qualify for action under the current suppression/eradication programs, which as discussed above, would be much of the AIPM Project Area, insect populations could build to high levels and then collapse, a cycle which normally occurs over several years.

Untreated forest stands would be those of low to moderate resource values, as defined by National Forest LRMP's, or by land managers and landowners, low to moderate site productivity, inaccessible high to low value stands, or those of non-host type, such as stands of pine or yellow poplar.

In susceptible untreated areas, the direct effects on vegetation would vary from site to site, depending upon the amount and condition of susceptible trees in the area. Generally, sites having a high oak component (greater than 80 percent) would be more impacted and experience heavier defoliation, reduced growth rates, and greater tree mortality than sites having fewer oaks. The cumulative effect would be a gradual change in forest tree species. Depending on the site, many susceptible oaks may be gradually replaced by less susceptible tree species such as yellow poplar, ash, pine and red maple. In lightly defoliated areas, no noticeable changes may occur.

Herrick and Gansner (1988) published information regarding changes in forest condition as a result of gypsy moth defoliation. Data was collected from 574 randomly established plots throughout central Pennsylvania over a seven year period. Plots were established in the leading edge of gypsy moth infestation in 1978, in forest stands of varying site indexes and varying species compositions. The severity and frequency of gypsy moth defoliation varied from plot to plot but, in general, was most severe in 1980, 1981, and 1982. None of the plots were sprayed, thinned, or cut during the seven-year study period. Results of the study showed changes in the numbers of trees per acre. The number of trees greater than 3 inches in diameter at breast height (dbh) increased on one-third of the plots; 55 per cent of the forest plots had fewer trees than before the outbreak. One-tenth of the plots had

reductions of more than 25 percent and on a few plots more than half the trees died. Before the gypsy moth outbreak, oaks averaged about 59 square feet (68 percent) of basal area per acre. By 1985, oak basal area was down to 55 square feet (63 percent) per acre, less than two-thirds of total stocking. Oaks are still the major component of these forests, but species less susceptible to gypsy moth defoliation, such as red maple, black gum, ash, and yellow poplar make up a greater portion of average stocking now than in 1978.

In a study reported by Quimby (1987), the progression of the gypsy moth and its effect on forest stands were measured annually on 57 permanent plots over a ten year period. Average oak mortality figures for the plots were: after one year of defoliation--18 percent, after two years of defoliation--89 percent, after three years of heavy defoliation--98 percent. Overall mortality in these stands ranged around 14 percent for one year of defoliation, 38 percent for two years of defoliation, and 48 percent for three years of defoliation. Quimby indicated that the data represents a worst-case situation.

Since it is probable that only high value forest stands, recreation areas, and forested residential areas would be treated under this alternative, timber mortality results similar to those described in the foregoing study could occur in untreated areas.

If extensive mortality occurs as a result of a gypsy moth infestation, major reductions in forest canopy could cause adverse effects to the area in both the short and long term. Mortality of older trees would allow more sunlight to reach the forest floor. This would encourage seed germination and growth of seedlings and other herbaceous vegetation. Seeds of species such as beech, birch, maple, cherry, yellow poplar and ash remain in the duff of the forest floor from one to seven years (Frank 1982). When the overstory trees are removed or die, dormant seed will germinate to establish reproduction. Competition will increase as these seedlings occupy the forest floor. Grasses, forbs and woody shrubs, such as huckleberry and laurel, will also compete for available moisture and nutrients. Since oak seedlings grow slower than other tree species, many will be quickly overtopped. Consequently, on some sites there will be fewer oaks in the future forest. Also, gypsy moth defoliation generally eliminates acorn production, and few sprouts will develop from the root systems of oaks that have been repeatedly defoliated because food reserves have been depleted (Frank 1982).

Another potential indirect effect on vegetation is wildfire hazard and difficulty of control. In the short term, there could be a significant increase in the amount of fuel (twigs, limbs and standing dead trees) available for wildfires as a result of gypsy moth-caused tree mortality. This fuel could cause a wildfire to spread faster,and if standing dead trees caught fire, would make control much more difficult. In addition, wildfire under these conditions would be detrimental to the oak reproduction that was present and further enhance the herbaceous plants and light-seeded tree species.

Wildlife and Wildlife Habitat

Wildlife are dependent upon their habitat. If gypsy moth outbreaks occur, changes in wildlife habitat (see preceding discussion on potential changes in vegetation), will cause changes in wildlife abundance, distribution and animal community composition. Wildlife responses to these changes can be groupėd into three general categories;

1. Response to changes in vegetative structure

2. Response to changes in food supply and

3. Response to indirect effects.

In addition, these three categories are different in terms of response when viewed from a short- or long-term perspective. The degree to which animals are impacted depends upon the species being evaluated. In reviewing the following description of effects, it is important to remember that no wildlife populations are known to be at risk from gypsy moth infestations.

Immediate effects of significant defoliation are associated with temporary elimination of forest canopy and ground cover foliage. Wildlife that feed, rest, nest or escape in forest vegetation may disperse to adjacent suitable habitat. Wildlife which feed from exposed perches or are accustomed to open habitats and wildlife opportunistic in feeding habits are attracted to recently defoliated areas. Long-term effects of repeated defoliations on vegetative structure usually results in an increase in habitat diversity (i.e., more standing snags, increased ground cover, increased habitat patchiness, and a more diverse plant community). Availability of habitat for high-canopy nesters decreases, while habitat increases for secondary-cavity nesters in areas with significant tree mortality.

Defoliations cause oak and other trees to abort hard mast crops in the year defoliation occurs (second year following defoliation in red oak group). Animals that utilize fall mast crops in defoliated areas shift to secondary food items or relocate. Long-term effects of repeated defoliations usually result in an increase in variety of foods available (in years defoliation does not occur). Fewer oak trees as a result of high mortality, however, would produce a proportionately lower volume of acorns per forested area. Even in areas without high oak mortality, reduced acorn crops are more likely following severe defoliations (Feede 1962).

Squirrels and other small game respond similar to songbird populations. They tolerate defoliation, some may disperse and all will become more susceptible to predation until refoliation occurs. Squirrels may disperse for longer periods of time (one year or longer), due to aborted mast crops in defoliated areas. Long-term effects due to composition changes in tree species, however, may actually benefit squirrels as a result of mixed tree species composition and more stable annual supplies of foods able to be stored for winter (Nixon, 1986).

Although little is known about defoliation impacts on wildlife, changes in bird habitat structure and tree species composition as a result of gypsy moth defoliation are likely to occur. Repeated defoliations increase tree mortality (especially oaks) producing an increased number of snags and an increase in understory shrub and herbaceous cover. Cooper and others (1987) conducted field studies in West Virginia from 1984-1986, and attempted to model the changes in bird communities in response to gypsy moth defoliation and mortality. Some of the results of this study follow:

-- At pre-outbreak levels, many bird species were observed eating gypsy moth larvae, but only the yellow-billed cuckoo seemed to feed preferentially on gypsy moth. Other birds observed feeding on larvae were great-crested flycatcher, black-capped chickadee, tufted titmouse, white-breasted nuthatch, wood thrush and rufous-sided towhee. These species are likely to eat gypsy moth larvae at any gypsy moth density, but at pre-outbreak levels, the gypsy moth is mostly an incidental food item.

-- At outbreak levels, food supplies for insectivores increase until insect prey availability responds to effects of severe defoliation (more than 50 percent).

Some species are able to take advantage of gypsy moth as a new food source, others will not. Birds alter foraging patterns and concentrate on trees that are not preferred hosts of gypsy moth. Birds were not observed to abandon defoliated areas entirely.

-- In general, gypsy moth defoliation-caused effects on various bird species are short-lived unless severe tree mortality occurs.

Over a period of time, these changes are likely to directly affect bird communities. Several investigations have shown that many bird species have definite foraging preferences for certain species of trees (Holmes and Robinson 1981, Robinson and Holmes 1984). Holmes, et al. (1986) showed that in a 16-year study of a New Hampshire forest, population fluctuations in some bird species coincided with changes in tree species composition. Increases in low and bark foraging, low and cavity nesting and open habitat bird species are associated with areas of high mortality. Overall, tree mortality should increase habitat variability, resulting in increased bird species richness.

Increased insect availability following years of significant defoliation (if tree mortality occurs) benefits ground-feeding birds, other insectivorous species (shrews, songbirds) and some omnivorous species such as rodents, opossum, skunk and raccoon (Hayden 1987, Smith 1985, Cooper and others 1987). Grouse habitat improves for breeding, nesting, feeding and brood cover as stem densities in lower canopy and ground vegetation increase. In addition, increases in numbers and density of standing snags may provide more nesting habitat for primary cavity nesters (woodpeckers) and more dead and down woody material used for cover of forest floor-dwelling animals (voles, mice, salamanders, etc.).

Wildlife incapable of relocating to areas of suitable habitat are susceptible to increased predation. Nests of perching birds are more susceptible to parasitism in and around defoliated areas. Eggs and young become more susceptible to mortality from environmental factors as a result of increased sunlight and wind (increased temperature, reduced humidity, increased solar radiation). Animals that must forage over greater distances become more susceptible to predation. Animals that must shift to secondary food sources may experience reductions in vigor.

Animals with large home ranges (greater than one square mile), such as white-tailed deer, black bear and wild turkey, are not directly affected by gypsy moth defoliations in the short term. Deer and bear avoid recently-defoliated areas when searching for food. Turkey (especially broods) are more likely to frequent edges of defoliated areas due to increased insect availability. Over the long term, changes in stand composition and vegetative structure of repeatedly defoliated stands (if significant mortality occurs) provide increased variety of food supplies for deer and turkey, and improved brood cover for turkey (Hayden, 1987).

Insects

As the gypsy moth spreads into new areas of the AIPM Project in Virginia and West Virginia, the insect will compete for food with native defoliating insects. Outbreak populations of these native Lepidopteran insects have in the past caused heavy defoliation and some tree mortality of hardwood trees located within the AIPM Project or in adjacent states. It is not uncommon to find several species of native defoliators, such as forest tent caterpillar, spring and fall cankerworms, leaftiers and spanworms, inhabiting the same hardwood stand infested with the gypsy moth. Such combinations often result in very heavy defoliation of a hardwood stand. Most of the common native defoliators by themselves seldom build to outbreak populations and

remain at near outbreak levels for more than one or two years before collapsing again to low levels. The period between such native outbreaks is often 10, 15 or more years in a given area.

It is possible that other native Lepidoptera, such as members of the giant silkworm moths and various butterflies that inhabit hardwood forests within the AIPM Project Area may also be directly impacted by the occurrence of the gypsy moth. The life cycle of many of these Lepidoptera may coincide with that of the gypsy moth in that the larval stages are feeding on hardwood foliage in the spring at or about the same time as the gypsy moth. Most of these insects have only one generation per year in the northeastern United States; others have more than one generation in the South. The giant silkworm moths produce some of the largest larvae and some of the largest and most colorful moths. Some occur as solitary feeders (possibly one or two larvae per tree or shrub) and in very low numbers in a given forest area or stand.

Numerous species of butterflies occur within the project area and many are known to inhabit hardwood forests, others in stand openings and others in very restricted habitats such as shale barrens, limestone barrens, sandstone barren ridgetops and wetlands. There are six Lepidoptera species listed as sensitive (table III-4) that may be directly impacted through competition for food and habitat by the gypsy moth.

There are other native insect species that occur in the hardwood forests within the AIPM Project Area that may be directly or indirectly impacted by the gypsy moth under this alternative. Insects that feed on flowers, foliage or seeds of oaks or other hardwoods defoliated by the gypsy moth would be affected by the gypsy moth since defoliation often eliminates the flowers and seeds of host trees. On the other hand, if oaks are replaced, other insects will benefit. Native ground beetles, ants and spiders may be positively impacted by the gypsy moth, providing additional prey for these insects. Wild bee colonies that occur within heavily defoliated areas may also suffer, depending upon the availability and distances to other sources of flowering trees, shrubs and grasses.

Since many of the native insects that occur within the AIPM Project Area also occur throughout the hardwood regions of the Eastern United States, and continue to occur in hardwood areas already infested by the gypsy moth, long-term direct, indirect or cumulative impacts on many of these insects are expected to be minimal. However, there undoubtedly will be some exceptions, especially with some giant silkworm species that may be eliminated from some localized areas. This may require a longer period of time for the insects to recolonize such areas. In other cases, butterflies and moths that have restricted habitats or are known to occur only in restricted forest locals may be negatively affected by the gypsy moth.

Endangered, Threatened and Sensitive Species

The American peregrine falcon is not directly affected by gypsy moth but may find prey more readily available in defoliated areas. The bald eagle is not directly affected by gypsy moth. However, adequate information is not available on effects of defoliation during critical periods of the nesting cycle most likely to occur at times of peak defoliation (incubation and brooding). Effects of gypsy moth on alder flycatcher and loggerhead shrike are thought to be insignificant. Bewick's wren may indirectly benefit from increased food supplies of bark beetles and other insects found in areas with tree mortality.

The Virginia northern flying squirrel is restricted to pure stands of evergreens (spruce, fir) or mixed forest of spruce, beech, maple and birch (Wells-Gosling and Hgangy 1984). Spruce and fir trees are not preferred and are avoided by the gypsy

moth except during severe outbreaks. If mortality of spruce and fir occurs, habitat conditions would support lower populations of squirrels. The southeastern shrew and other shrews listed in table III-4 are likely to benefit by the additional food supply of gypsy moths.

Virginia big-eared bat and Indiana bat colonies are not known to be affected by significant defoliations. Unless all available foraging areas are completely defoliated, effects are likely to be insignificant. If present, Virginia big-eared bats and Indiana bats may frequent the edge of defoliated areas and crowns of trees within defoliated areas in search of prey. In addition, Indiana bats may benefit from tree mortality by utilizing exfoliating bark of standing snags as summer roosts or maternity colonies. Keen's myotis and eastern small-footed bat behavior in response to the gypsy moth are thought to be similar.

There are no known effects of gypsy moth on snowshoe hare or New England cottontail rabbit.

Effects of gypsy moth on endangered, threatened or sensitive reptiles, amphibians and snails listed in tables III-3 and III-4 result from temporary changes in habitat and site conditions or possible reductions in food supplies.

Populations of clams, crustaceans and fish listed in tables III-3 and III-4 respond to changes in water quality. Information is limited for estimating the effects of increased nutrient loading and oxygen depletion (Sharpe, 1982) caused by gypsy moth outbreak defoliations. The level of increase in nutrients may actually improve water quality for aquatic plants and animals.

Effects of gypsy moth defoliations on insects listed as sensitive (table III-4) are unknown.

Plants are directly affected by outbreaks of defoliating insects from a physiological standpoint. Defoliation interrupts normal patterns of translocation of water, minerals and production of food. However, gypsy moth is not known to feed on swamp pink, running buffalo clover, shale barren rockcress or harparella.

Fish and Aquatic Ecosystems

Water quality dictates the health and well being of aquatic ecosystems which include fish. Gypsy moth defoliations may directly affect water quality in three ways:

1. Increase water yield and augment stream flow;

2. Increase sunlight intensity and duration on exposed water surfaces;

3. Increase nutrient deposition in the form of partially-eaten vegetation and insect frass.

The magnitude of impacts of gypsy moth varies from watershed to watershed, depending upon the intensity and extent of defoliation and the forest composition of the area. When reviewing the following description of effects, keep in mind there are no known aquatic plants or organisms at risk from the gypsy moth.

Increases in water yield during the growing season as a result of insect defoliation can be expected (Corbett and Heilman 1975; Love 1955; Potts 1984). Increased water yields affected low flows but had no detectable effects on peak flows (Potts 1984; Helvey and Tiedemann 1978). Sharpe (1982) states that gypsy moth defoliation

increased water recharge of aquifers in Central Pennsylvania. Temporary increases in water supply during the growing season are likely to be beneficial to aquatic ecosystems (Corbett and Lynch 1987; Sharpe 1982).

Increased sunlight intensities and duration on water surfaces increase water temperature, which may adversely influence water chemistry and life functions of aquatic organisms. Increases in mean maximum temperature for streams on Newark, New Jersey watersheds where streamside vegetation had been killed with herbicides were reported by Corbett and Heilman in 1975. This study, however, does not completely simulate gypsy moth defoliation effects on water quality because:

1. Refoliation of gypsy moth defoliated areas usually occurs before summer stream temperatures become critical in July-August, and herbicides used on Newark watersheds reduced canopy foliage cover from 3 to 31 percent of watershed areas throughout the growing season:

2. Mountain streamside vegetation contains a significant component of rhododendron and yellow poplar (Sharpe 1982), which are species avoided by gypsy moth but susceptible to herbicides.

In addition, Sharpe (1982) suggests that stream temperature influenced by gypsy moth defoliation in riparian zones of streams is of little significance.

Grace (1986) concluded that although more nutrients are recycled following gypsy moth defoliation, most nutrients are in the upper layers of the forest floor at the end of the summer. Sharpe (1982) suggests that increases in stream nutrient concentrations as a result of gypsy moth defoliation are unlikely to be greater than increases from clear-cutting. Corbett and Lynch (1987) reported that clear-cutting 45 percent of a watershed had little effect on nutrient concentrations. If insect larvae, frass and partially eaten leaves accumulate in extremely small water bodies or streams with low water exchange rates, temporary effects would be similar to other organic pollution, i.e., taste, odor, color and bacterial-related problems (Sharpe 1982).

Over the long term, changes in plant communities along streams as a result of gypsy moth infestations are not known to have any appreciable effects on aquatic ecosystems.

Soil

Defoliation by the gypsy moth can speed the transfer of nutrients from vegetation to the soil surface. Grace (1986) studied litter fall on defoliated and undefoliated plots in a Pennsylvania oak forest. Litter was collected throughout the year, separated by plant and insect components, and analyzed for dry weight and five major nutrients. The plots were covered by even-aged, second-growth stands of oak typical of central Pennsylvania. Red oak and black oak were the most numerous overstory species on the plots, while red maple, white oak, chestnut oak, and scarlet oak were also abundant. Yellow-poplar and black gum were found infrequently. The closed overstory canopy allowed for a sparse understory except for mountain laurel, which was dense in some areas.

Total biomass estimates of litter falling on the defoliated and foliated plots were not significantly different but the timing and composition of litter fall were. Within the foliated plots, 90 percent of the litter was deposited during the autumn and tree leaves were the major litter component. Major litter components within the defoliated plots included insect frass, leaf fragments, and tree leaves, with 56 percent of the litter being deposited during the growing season.

Gypsy moth defoliation caused a statistically significant increase in the quantities of nitrogen, phosphorus, and potassium and a significant decrease in the quantity of calcium in the litter fall. Nitrogen returned on the defoliated areas was 68 percent greater than on foliated plots; potassium was 82 percent greater; phosphorus was 21 percent greater, and magnesium showed trends of a slight increase. Conversely, the return of calcium was 27 percent lower on the defoliated areas. These differences were attributed to the gypsy moth altering the composition and seasonal distribution of the litter fall (Grace 1986).

There is little evidence that these nutrients are lost from the site. In fact, it may benefit regeneration that is already established on the site, when the overstory trees die (Corbett and Lynch 1987). The increase in available nutrients is of a temporary nature and ends when the gypsy moth population collapses.

Water Quality

There is a definite increase in water yield when watersheds are heavily defoliated. The reduction in interception and transpiration losses due to the "thinned" forest canopy leads to increased soil moisture; thus a larger percentage of precipitation is converted to streamflow. These temporary increases in water supply during the growing season are likely to be beneficial (Corbett and Lynch 1987).

Studies of water yield and quality were conducted on the Newark, New Jersey Pequannock Watershed in 1971. The study coincided with a severe gypsy moth outbreak in New Jersey. Two small watersheds in the oak-hickory forest type were studied. Watershed 2 (42 acres) was completely forested at the time of the gypsy moth defoliation, while watershed 3 (23 acres) had a small percentage of its area in overstory vegetation because the vegetation had been deadened 5 years earlier. At least 75 percent of the overstory was defoliated on watershed 2 and only minor defoliation on watershed 3. The gypsy moth defoliation had a significant influence on water yield. On both these watersheds, annual water yield increased by 5.82 inches when estimated by the control watershed technique, while the single-watershed calibration method estimated the increase at 4.89 inches. Eighty percent of the yield increase occurred during the growing season. Using the average of the two estimates, 5.36 inches, water production was increased by 146,000 gal/acre due to defoliation (Corbett and Lynch, 1987).

During heavy periods of rain, it is possible that significant accumulations of insect larvae, frass and leaf parts may be washed into small streams located in heavily defoliated areas. However, these effects would be of short duration (Corbett and Lynch 1987). Such material, when found in small streams, lakes or ponds, affects the taste, odor and color of the water.

Increased levels of bacteria in small streams, ponds and lakes may also occur in heavily defoliated areas. Corbett and Lynch (1987) reported on a study in 1984-85, where water samples were collected from three pristine forest streams (Bear Gap Run, Wildcat Run, and Sweet Root) located on the Buchanan State Forest, Bedford County, Pennsylvania. Water samples were collected weekly at 4 points along Bear Gap Run, 5 points on Sweet Root and 2 points along Wildcat Run. Sampling began in April 1984 and continued through August 1985. Each of the watersheds was heavily defoliated (85 to 95 percent) in May-June 1984. This was followed by defoliation again in 1985, but it was less severe than the previous year. Heavy tree mortality occurred on the three watersheds as a direct result of the gypsy moth defoliation.

Analysis of the water samples for the occurrence of bacteria revealed a large increase in total fecal coliform and fecal streptococcal densities in the three streams during the period of heavy (May-June) defoliation. Fecal coliform densities ranged from a low of near zero to a high 90/100 ml, and fecal streptococci ranged from 0 to a high of 25,000/100 ml. The fecal coliform/fecal streptococcal ratios indicate that these indicator organisms were from nonhuman sources (Corbett and Lynch 1987) and likely pose no threat to human health.

Little information is available concerning the effect of gypsy moth defoliation and associated mortality on stream temperature. Swift and Messer (1971) reported increases in summer maximum temperatures of 5°F following the deadening of riparian overstory and the cutting of understory vegetation at the Coweeta Hydrologic Laboratory. Cutting of the dead overstory trees caused maximum stream temperatures to rise only 1°F, indicating that topographic shading or ground water inflow may have helped minimize temperature increases.

Corbett and Heilman (1975) reported a 4°F increase in the mean maximum temperature for a stream on the Newark, New Jersey municipal watersheds where riparian vegetation has been deadened. This suggests that water temperature increases could occur as a result of gypsy moth defoliation. However, since most of the trees along streams or in riparian areas are not preferred by the gypsy moth, significant increases in water temperature are not anticipated.

It is reasonable to expect that heavy gypsy moth defoliation in June-July would cause small increases in the temperatures of small streams. However, the effect of such temperature increases on aquatic insect populations or native or stocked trout is probably insignificant.

Air Quality

No effect on air quality is anticipated under this alternative.

Visual Resource

The Appalachian Mountains, Blue Ridge Mountains and Shenandoah Valley are renowned for their scenic beauty. Implementation of alternative 1 would in some locations allow the gypsy moth to create direct impact on the visual resource of these areas. As populations build and defoliation intensifies, the resulting impacts will become visible from the many scenic vistas and parkways. Some individuals may regard the defoliation as unsightly; to others it may represent a curiosity. This condition will be of short duration, lasting until the trees refoliate in mid-July. Many of the refoliated trees will exhibit thin crowns and smaller, off-colored (chlorotic) leaves. In the fall, the second crop of foliage seldom produces the bright fall colors as seen in undefoliated areas. However, long-term effects to the visual resource may be enhanced due to an increase in species that exhibit more fall foliage color.

Areas of heavy gypsy moth-caused mortality will be visible to individuals the following spring, summer and early fall from scenic vistas and overlooks. Duration of impacts on the visual resources will depend on the location, size of area and amount of tree mortality.

Recreation

In most cases the high value parks and recreation areas would receive some type of treatment to prevent excessive defoliation and insect nuisance under State/Federal cooperative suppression projects. However, depending on the intervention tactic used and precautions implemented, some decline in usage could be expected. This decline in use would result from closure of developed recreation areas during treatment operations and objections of some users in using treated areas.

In other high value parks, recreation areas and commercial campgrounds that are not treated due to lack of funds or other restrictions, visitor use may decline. The amount of reduced use will depend upon gypsy moth population levels, intensity of defoliation and related insect nuisance. In addition, those areas that experience heavy defoliation may have increased tree mortality and associated removal and replacement costs. If no suppression actions are taken, increase in gypsy moth populations increase the probability of artificial transport of gypsy moth life stages.

Effects of gypsy moth defoliation on dispersed recreation under this alternative would be difficult to estimate. In some situations it would displace the use from infested to uninfested areas of the AIPM Project. Although the total amount of dispersed use would not decrease significantly throughout the area, the quality of the experience would be greatly reduced for people involved in viewing scenery for pleasure. Other dispersed activities may not be directly affected to any measurable degree by outbreak populations of the insect. People involved in trout fishing on a favorite remote stream will likely do so despite the amount of defoliation on adjacent hardwoods so long as the fishing success meets expectations. Hikers on trails that pass through defoliated areas are not expected to avoid traversing such areas. In many cases, dispersed recreation users will view defoliation under this "no action" alternative synonymous with "no management".

While moderate to heavy defoliation can be expected to directly affect some dispersed recreation activities due to nuisance and aesthetic degradation during the late spring and early summer, these impacts will be of short duration. However, if heavy tree mortality occurs, this can directly and indirectly affect the recreational setting by first denying users the green, shaded forest environment expected and later by increasing the risk to recreationists from hazard trees.

Cultural and Historical Resources

No effects on cultural and historical resources are anticipated under this alternative from the AIPM Program.

Public Health

There would be no impacts to public health from AIPM Program intervention tactics under this alternative.

Within the untreated areas, some individuals may experience minor allergic reactions to the fine gypsy moth larvae hairs (Tuthill and others 1984).

Socio-economic Effects

Under this alternative, there may be a direct effect on local timber markets in portions of the AIPM Project Area. Untreated private or industrial landowners may

opt to harvest their timber to reduce potential losses to gypsy moth. This could cause localized flooding of timber markets adversely affecting stumpage prices. Local landowners would probably be unable to sell all of the volume of dead hardwood timber. In many cases, this impact would represent a significant loss to individual landowners in terms of expected return on investment. This process may be repeated as the insect spreads southward through the AIPM Project Area into and through local market areas. In many of the remote or inaccessible areas, the dead timber will not be salvaged.

In areas behind the advancing gypsy moth front of infestation, defoliating populations will begin to collapse. Tree mortality and associated salvage sales will decline, thus stabilizing timber markets.

In areas where mortality is extensive, some private landowners may decide to convert the land to other uses where possible. Other private forests may receive minimum attention and investment. In an extreme case, prominence of forest-related industries and local economies may be moderately affected.

Prime Farmland and Rangeland

There would be no effect to prime farmland and rangeland from the AIPM Program intervention tactics under this alternative because these areas are normally unforested.

Wetlands and Flood Plains

There would be no effect to wetlands and flood plains from uncontrolled gypsy moth infestations.

Consumers, Civil Rights, Minority Groups and Women

None of these groups are likely to be significantly affected by implementation of this alternative.

Wilderness

Estimated effects of gypsy moth control are based on their impact on wilderness attributes and values. The gypsy moth is considered an exotic species. It is not one of the natural ecological forces that operate in the Appalachian Mountain forests. In wilderness, therefore, they are not a component of the natural process and impact the wilderness character. Likewise, gypsy moth intervention tactics also impact wilderness attributes and values. The primary attributes of wilderness are natural integrity, apparent naturalness, opportunities for primitive recreation, and opportunities for solitude. The supplemental attributes include outstanding ecological, geological, cultural and historical features. Scenic values include vegetation patterns, and natural formations of land, rock and water.

Natural Integrity

Under alternative 1, natural integrity would be affected by the gypsy moth. Susceptible wilderness would reflect a condition primarily shaped by the forces of nature, although in this case, through an exotic insect introduced by man. This alternative would not allow human interference on the wilderness resource for gypsy moth control under the AIPM Program.

In general, the physical and biological impacts created by the gypsy moth in wilderness under this alternative will be similar to those described under the general project area.

The effects of this alternative would allow natural processes to operate in the presence of gypsy moth. This alternative would allow processes to occur that would change the forest composition of the wilderness in a manner not normally expected. Wilderness would be maintained so that ecosystems are not affected by human manipulation, but influenced by gypsy moth.

Apparent Naturalness

This attribute is closely related to natural integrity and is influenced by the same impacts as well as by the evidence of human activities in the wilderness. Alternative 1 would not detract from the goal of allowing existing human evidence to slowly fade away.

This attribute would be adversely affected by allowing the gypsy moth, an exotic pest, to go unchecked in wilderness. Gypsy moth caused defoliation, tree mortality and related impacts to the wilderness ecosystem would be readily apparent to the public. There could be direct effects on vegetation, wildlife, soil and water quality under this alternative. Biological diversity could be affected as the gypsy moth altered the natural habitat, competed with other organisms for food and/or provided an unnatural supply of food. These effects would be cumulative if infestations defoliated vegetation and caused mortality in following years.

Opportunities for Primitive Recreation

Alternative 1 would allow for defoliation and mortality of existing trees and subsequently the establishment of new plant growth. This impact may either contribute or detract from the recreation experience. The direct effects of dead trees and new plant growth would allow for a high degree of challenge and risk. Some wilderness visitors would not use areas where high populations of gypsy moth exist, thus reducing certain benefits for them. Other visitors may choose these areas for the physical and mental challenges as well as the primitive conditions created by the gypsy moth.

The indirect and cumulative effects of allowing gypsy moth in wilderness would provide a change in vegetation and balance of wildlife over time. This would change the existing physical and mental challenges and the variety of primitive recreation opportunities.

Opportunities for Solitude

The direct effect of alternative 1 would be to reduce the vegetative screening or eliminate some stands of trees for a period of time. Many of the defoliated hardwoods will refoliate to again provide screening and opportunities for solitude. If extensive mortality occurs, regeneration should occur in approximately 5 years and restore vegetative screening. Opportunities for solitude may increase because the dense undergrowth would offer more solitude to those visitors willing to penetrate it and visitors would feel that they were isolated from civilization.

The indirect and cumulative effects of this alternative would allow a mix of new species to succeed susceptible hardwoods in the stand composition and maintain the opportunities for solitude over time. As evidence of past human activities disappeared, the visitor would continue to feel removed from civilization.

Supplemental Attributes

The geological, cultural and historical features would not be directly, indirectly or cumulatively affected by gypsy moth. The direct effects of alternative 1 may be to reduce the number and size of old growth trees. At high population levels, the gypsy moth could also impact other ecological features in wilderness, such as unique floral communities, unique aquatic ecosystems, or threatened or endangered species of plants or animals. The magnitude and intensity of impacts would depend on the extent and intensity of gypsy moth populations and the susceptibility of the forest stands to gypsy moth defoliation and mortality. The cumulative effects should serve to maintain a balance of old growth trees with younger trees, providing other natural processes occur.

The scientific value of wilderness as a base line area where natural processes are allowed to operate without interference by man will not be impacted. The wilderness, if left untreated, would show how nature copes with gypsy moth in a long-term sense.

Scenic Values

Alternative 1 would directly affect scenic values. If large numbers of defoliated trees occur, scenic values will be impacted until the trees refoliate later in the season. Mortality associated with defoliation would produce longer-lasting impacts as dead, standing trees fall and decompose. Scenic values would improve with time as the area became revegetated.

The indirect and cumulative effects of this alternative would be minimal as the scenic values of the landscape qualities of form, line, color, texture and variety would be maintained over time. Different species' composition and density will produce a pattern of vegetation comparable to the preinfestation landscape. This effect could pertain to all wildernesses and in the long term maintain scenic values.

Action Alternatives

The following discussion of action alternatives that may be considered for implementation in the AIPM Project Area involves a range of IPM tactics, including no treatment. Prior to the implementation of any selected alternative and related intervention tactics, a site-specific environmental analysis will be completed on each area considered for treatment and documented as appropriate. The analysis will determine the need for treatment and the range of possible intervention tactics that may be used. AIPM personnel will coordinate with appropriate landowner(s) or manager(s) to develop an effective intervention strategy consistent with management objectives and related biological considerations of the area. Mitigation measures and their effectiveness will be identified to minimize as many of the adverse environmental impacts as possible.

Within the General Project Area, some landowners may object to the use of any intervention tactic contained in these alternatives. Should this occur, gypsy moth populations may eventually build to defoliating levels in untreated areas. Efforts would be made to protect adjacent resources by use of appropriate intervention methods in this alternative on surrounding forest lands to reduce the spread, population build-up and associated impacts outside the untreated areas.

ALTERNATIVE 2

In the General Project Area, gypsy moth specific intervention tactics and biological tactics would be used against the gypsy moth. Gypsy moth specific tactics consist of mass trapping, disparlure (tape or flakes), inherited sterility, NPV, and parasites that only affect the gypsy moth. Biological tactics include Bacillus thuringiensis (Bt) and all parasites and predators. These tactics are normally used in areas having very light (less than 100 egg masses/acre) gypsy moth populations. At higher population levels, (greater than 100 egg masses/acre), NPV or Bt could be used to reduce larval populations to prevent defoliation and mortality.

These tactics may be employed individually or in combination, depending upon gypsy moth population levels and management objectives. For example, application of NPV or Bt in April or May could be used to reduce larval populations followed by later applications of disparlure in late June or July to disrupt male moth mating, or mass trapping of male moths. Parasites, depending upon the gypsy moth stage targeted, could also be combined with earlier application of either Gypchek or Bt.

The use of the inherited sterility tactic, however, would probably not be combined with any other intervention tactic since success requires maximum survival and growth of the introduced sterile insects to mate with as many native gypsy moths as possible.

Vegetation

Implementation of alternative 2 would, depending upon the intervention tactic(s) used, have little direct effect upon the vegetative components in the treatment area. Since most of the gypsy moth specific tactics are employed against light populations, only minor defoliation would likely occur except for the inherited sterility tactic described in the following paragraph. At higher population levels (greater than 100 egg masses per acre) where NPV, Bt, or combinations would be used, significantly less defoliation would be expected to occur than in similar areas under the "No Action" alternative. The effects on vegetation by employing this alternative would be to reduce larval populations, defoliation, and subsequent tree mortality the following year within the treatment area.

The use of the inherited sterility tactic (release of partially sterilized eggs) may increase the amount of defoliation over alternative 1 the first year because of an associated increase in feeding larvae. The amount of defoliation resulting from this tactic would depend upon the gypsy moth population in the treatment area, the amount of susceptible vegetation, the amount of eggs introduced into an area and survival of the introduced insects. Since this tactic is normally effective in areas having extremely light populations, only a slight increase in defoliation would be expected to occur. The effects of this tactic would result in much lower gypsy moth populations in the area the following year.

Wildlife and Wildlife Habitat

In areas where this alternative is implemented, impacts on wildlife or wildlife habitat would be proportional to the degree of gypsy moth control achieved.

Application of gypsy moth-specific tactics (disparlure, inherited sterility, mass trapping, nucleopolyhedrosis virus) are not known to have any direct, effects on wildlife or wildlife habitat (Lautenschlager and Others, 1978; 1979). Release of sterile gypsy moths increase existing gypsy moth populations and may increase food

supplies for some insect predators. However, the introduced insects may also feed on some hardwood flowers, reducing the mast crop in the treated areas.

Application of gypsy moth non-specific tactics (parasite and predator release, Bt) are not known to have any direct effects on wildlife or wildlife habitat (USDA FEIS, 1985). Release of predators is additive to existing insect populations and may temporarily increase food supplies for some insect eaters. Release of parasites, predators or Bt may reduce populations of leaf-chewing insects (Brown and others 1984) and food supplies for some insect predators.

Non-game birds that often prey upon native defoliating Lepidoptera may be indirectly impacted by the application of Bt. These insects are often a major food source for both mature and immature birds. The extent of the indirect impact will depend upon the size of the treatment area and the availability of alternate food sources. In treatment blocks that are relatively small (25 to 50 acres), birds may locate sufficient Lepidoptera prey in adjacent untreated areas. Larger treatment areas may force many species to alter their foraging to search for additional food sources within the area. In many cases, Lepidoptera feeding on understory shrubs or other vegetation may only be slightly affected by the Bt applications, since most of the material is intercepted by the forest canopy. Canopy-foraging species may alter their foraging to locate sufficient larvae on the understory vegetation.

Because the effectiveness of Bt declines rapidly after application, normally lasting from seven to ten days, native insects emerging after this period would not be affected and become a food source to many bird species (USDA FEIS, 1985). Following aerial spraying of Bt in Illinois, bird species occurrence or diversity remained relatively the same (McGowan, 1985 unpub. report).

No additional indirect or cumulative impacts on wildlife or habitats are anticipated unless the same area requires treatment with Bt the following year. In such cases, native Lepidoptera utilized as food by various birds would again be impacted in a similar manner as described. None of the native Lepidoptera are likely to be eliminated from the area.

Insects

Bt applications will affect native Lepidoptera that are feeding on foliage treated with Bt. Some forest Lepidoptera species that may be found in treatment areas at time of application which are susceptible to Bt are listed in table IV-1 (Abbott Laboratories 1986 Specimen Label).

The use of Bt, however, only impacts those native Lepidoptera that are actively feeding in the treatment area during or shortly after the time of application. The significance of this impact on native populations would depend upon the size of the treatment area, the number of Bt applications used and species with a similar life cycle to gypsy moth. Multiple treatments create the potential for two types of cumulative effects to occur.

1. Repeated treatments of the same area during the same growing season are likely to prolong effects associated with single treatments.

2. If insect populations have not recovered, treatments in subsequent years of the same area or adjacent areas may reduce or perpetuate low populations of Bt, susceptible Lepidoptera.

Table IV-1.--Some Lepidoptera species susceptible to infection with Baccillus thuringiensis

Scientific Name	Common Name
Alsophila pometaria	Fall cankerworm
Ennomos subsignarius	Elm spanworm
Erannis tiliaria	Linden looper
Malacosoma disstria	Forest tent caterpillar
Paleacrita vernata	Spring cankerworm
Lymantria dispar	Gypsy moth
Thyridopteryx ephemeraeformis	Bagworm

Those Lepidoptera that feed on understory shrubs and plants are generally only slightly impacted by the aerial application of *Bt* since most of this insecticide is deposited on the upper forest canopy.

Single or multiple applications of *Bt* may indirectly impact predators of *Bt*-susceptible Lepidoptera by temporarily reducing food supplies. Surveys of *Bt*-treated areas in Illinois show no adverse impacts on native moths. In fact, more individual moths were recorded in sprayed areas than unsprayed areas two months after treatment (McGowan unpub. report).

Endangered, Threatened and Sensitive Species

The bald eagle, American peregrine falcon, Virginia northern flying squirrel, Cheat Mountain salamander, Shenandoah salamander, Roanoke logperch, all endangered and threatened clams, snails, crustaceans or plants are not known to be directly affected by applications of biological or gypsy moth specific tactics. Indiana bat, Virginia big-eared bat, Small-footed bat, Keen's myotis and Rafenesque's big-eared bat may be indirectly affected by temporary reductions of Lepidopterous insects as a food source in treated areas. The degree to which these species are affected depends upon the ratio of treated to untreated bat foraging habitat and the availability of other insects for food. None of these species relies exclusively on *Bt*-susceptible Lepidopterous species affected by treatments proposed in this alternative. Effects of gypsy moth population outbreaks on habitat for Virginia northern flying squirrel, Virginia big-eared bat, Indiana bat, bald eagle, Cheat Mountain salamander, Shenandoah salamander, Madison Cave isopod and endangered, threatened and sensitive plants would be reduced to the degree applied intervention techniques are successful. Lepidoptera species such as the marbled underwing moth, precious underwing moth, Hebard's nocutid moth, tawny cresent butterfly, regal fritillary butterfly, and chestnut clearwing moth (table III-4) may be susceptible to applications of *Bt*.

Fish and Aquatic Ecosystems

Implementing alternative 2 would reduce the effects of gypsy moth defoliations on fish and aquatic ecosystems to the degree gypsy moth populations are controlled. Fish are not known to be affected directly by *Bt* or NPV. Acute *Bt* toxicity tests conducted on rainbow trout, bluegills and coho salmon identified no impacts on these

species (USDA FEIS 1985). No aquatic insects are known to be affected by applications of Bt or NPV in watersheds.

Successful applications of Bt or NPV may temporarily increase food supplies for fish and other opportunistic water feeders if some larvae fall into streams when they succumb to treatment. There are no known effects of Bt or NPV on fish or aquatic ecosystems.

Soil

None of the intervention tactics in this alternative are likely to have any direct, indirect, or cumulative impacts on the soil or litter in selected treatment areas. If the tactics implemented prevent gypsy moth populations from building to defoliating levels, the rapid transfer of nutrients from vegetation to the soil surface as discussed under the "No Action" alternative will not occur.

Gypsy moth NPV has no known effect on the environment in which it is applied. The virus has a shorter residual persistence in soil than the naturally occurring NPV (USDA FEIS 1985). Studies on the fate of Bt indicate that the spores will persist in the soil for several weeks, depending on soil type, soil flora, soil pH and solar radiation (USDA FEIS 1985).

Water Quality

None of the intervention tactics proposed for use in this alternative are expected to affect water resources found within selected treatment areas. Streams flowing out of watersheds or forest stands that may be treated with NPV or Bt are not expected to experience any water quality degradation.

If the intervention tactics successfully prevent population buildup and excessive defoliation by the gypsy moth, effects on soil moisture and water yield, temperature and quality as described under the "No Action" alternative will be prevented or reduced.

Air Quality

No effects on air quality are anticipated under this alternative.

Visual Resource

If the intervention tactics prevent or reduce defoliation in scenic areas, this alternative would be expected to maintain visual and scenic values within the general project areas. Some light defoliation could occur in treatment areas; however, the effects on the visual resource would be minimal.

Recreation

Some high value parks, recreation areas, and commercial campgrounds may require treatment. If a microbial insecticide is used, some decline in use may result if campgrounds are closed during treatment. Users will react differently, with some preferring treatment areas while others avoid them. This will have an effect on use.

The effect of implementing this alternative on dispersed recreation should be minimal. Individuals involved in hiking, fishing, hunting, viewing scenery for pleasure, and other dispersed activities should experience only minor impacts, if any.

Cultural and Historical Resources

No effects on the cultural or historical resources are anticipated under this alternative.

Public Health

This alternative incorporates intervention with two microbial insecticides, *Bacillus thuringiensis*, (*Bt*), and the gypsy moth host specific nucleopolyhedrosis virus (NPV).

Bt is generally considered to cause no threat to human health. In over 18 years of *Bt* use, there have been no scientifically documented cases or evidence of *Bt*-caused illness directly attributable to forestry-use situations.

Three incidents of human infection from *Bt* have been reported. In one case, a laboratory technician accidentally stuck a *Bt*-contaminated needle into his finger, which caused a skin infection (USDA FEIS 1985). The variety of *Bt* that caused this infection is not the variety that is used in gypsy moth suppression. The second reported case involved *Bt* that was splashed into the eye of a farmworker, resulting in an eye ulcer (USDA FEIS 1985). The third incident was reported in the Fall of 1987 and involved three members of a Kansas City, Missouri family who became ill after eating honey received from a Maine retail establishment. Their illness was characterized by vomiting and diarrhea which resolved itself after 18 hours. Analysis of the honey at the University of Missouri in Kansas City tentatively identified the causal agent as *Bacillus cereus*, a common diarrhea-causing organism. The Centers for Disease Control in Atlanta, Georgia examined the isolate for confirmation and identified it as *B. thuringiensis* rather than *B. cereus*. The CDC feels, from an epidemiological standpoint, there is insufficient evidence to implicate *Bt* as the cause for this food poisoning, nor is there any need to curtail the use of *Bt* in gypsy moth suppression programs (Hoover, 1987).

The Ministry of Natural Resources in Ontario, Canada temporarily suspended *Bt* spraying during 1987 when it was discovered that its stock of *Bt* insecticide was contaminated with unexpectedly high levels of *Streptococcus faecium* and *S. faecalis*. Spraying was resumed after Health and Welfare Canada determined that the contamination posed no concerns in terms of adverse health effects (Churcher 1987).

Both the USDA Forest Service and the US Environmental Protection Agency have reviewed the concerns about *Bt* and believe they are unfounded (see letter concerning Biological Pesticide Bioburden, appendix D).

The use of the nucleopolyhedrosis virus (NPV) in this alternative is not expected to pose any human health concerns. NPV has shown no adverse effects on fish, game birds, vertebrates or man. The possibility that the gypsy moth NPV may be related to the arthropod borne (Arbo) viruses and other viruses which infect man has been investigated. In studies carried out in 1974-1975 at Yale University, all of the known arboviruses were found to bear no relation to the NPV of the gypsy moth. Other viruses, such as Herpes, were also found to be unrelated to the gypsy moth NPV (Mazzone and others, 1976). Since Gypchek is produced from gypsy moth larvae that have been inoculated and killed by NPV, the powder formulation will contain a small number of insect parts and other microorganisms. The occurrence of and possible significance of the microorganisms associated with the production of NPV was investigated. Results of the study failed to detect any obligate anaerobic or fecal coliform bacteria and no primary mammalian pathogenic bacteria or fungi in the NPV material samples. However, the presence of some opportunistic pathogens was

detected, indicating the need for rigorous quality control of production batches (Podgwaite and others 1983).

Socio-economic Effects

This alternative, if implemented, should reduce or minimize the anticipated drop in timber prices in local and regional timber markets that could occur under alternative 1. Reducing gypsy moth populations will minimize defoliation and associated timber mortality. Local timber prices should not be affected by gypsy moth.

Prime Farmland and Rangeland

It is possible that some drift of NPV or Bt applications over forested areas may occur on adjacent farm or rangeland. However, neither biological insecticide poses any known risk to range animals, and no feed crop tolerances have been set by EPA.

Wetlands and Flood Plains

AIPM intervention tactics will not physically impact or alter wetlands and flood plains.

Consumers, Civil Rights, Minority Groups, and Women

None of these groups are likely to be affected by implementation of this alternative.

Wilderness

Under this alternative, no intervention tactics would be applied to the wilderness resource, and the impacts would be similar to those described under alternative 1. Population monitoring would continue in all wildernesses to determine population trends and levels.

ALTERNATIVE 3

This alternative includes the gypsy moth specific and biological intervention tactics discussed in alternative 2, plus the addition of the insect growth regulator, diflubenzuron or various combinations of these tactics in the General Project Area.

Vegetation

Implementation of this alternative would have similar effects on vegetation as those described in alternative 2. It is anticipated that diflubenzuron would be applied to forested areas in the AIPM Project that have rapidly building or very heavy gypsy moth populations that would result in moderate to heavy defoliation. The use of this insecticide would greatly reduce gypsy moth populations and defoliation, such that other less impacting tactics, such as disparlure flakes, could be used the following year to maintain populations at low levels. Use of diflubenzuron may also protect the flowers as well as the foliage of many hardwoods and maintain seed production at near normal levels.

Wildlife and Wildlife Habitat

Alternative 3, if implemented, would have similar effects on wildlife and wildlife habitat as those described for alternative 2. Because diflubenzuron is the treatment most effective in reducing gypsy moth populations capable of complete

defoliation, the likelihood of occurrence of effects of gypsy moth described in alternative 1 would be minimized when diflubenzuron is used.

Diflubenzuron is not known to adversely affect mammals or birds. (USDA FEIS 1985A, Willcox and Coffey 1978).

The following paragraph is taken from the Final Environmental Impact Statement, as supplemented, for Gypsy Moth Suppression and Eradication Projects:

> "The acute toxicity of diflubenzuron to mammals has been investigated by Philips-Duphar B.V., Harris Laboratories, and the Huntingdon Research Center (Willcox and Coffey 1978). Because of its mode of action, the interruption of chitin synthesis on the insect, diflubenzuron has low mammalian toxicity. The very low toxicity of diflubenzuron for mammalian and nonmammalian species, exclusive of insects and certain chitin-containing arthropods is in part related to the ability of the compound to be absorbed by the animal exposed and its ability to biochemically detoxify and eliminate diflubenzuron from its system (Willcox and Coffey 1978)."

Additional information on the impact of diflubenzuron applied at rates from 0.03 to 0.06 lb. active ingredient per acre in several different forest ecosystem is presented in the USDA FEIS 1985.

Insects

No significant treatment effects from the use of diflubenzuron were found for herbivorous Hemiptera (bugs), Homoptera (aphids), Pentatomidae (ambush bugs), Phymatidae (stink bugs), Reduviidae (assassin bugs), Salticidae (jumping spiders), Clubionidae (two-clawed hunting spiders), Dictynidae (hackel banded weaver spiders), herbivorous Condylognatha (burrower bugs), taxonomic richness or predaceous arthropod taxonomic richness. Gypsy moth, Geometroidea (geometrid moths), Sphingidae (sphinx moths), Noctuoidea (cutworm moths), Tenthredinoidea (sawflies), and Gryllidae (crickets) populations and mandibulate herbivorous taxonomic richness were consistently lower on treated plots but not significant for herbivorous taxonomic richness in oak stands, macrolepidoptera (not including gypsy moth or <u>Itame</u> <u>pustularia</u>) in chestnut oak and mandibulate herbivorous arthropods (excluding Lepidoptera) in red maple stands. Microlepidoptera appeared to be least affected by application of Dimilin (Martinat and others 1988), possibly because of feeding habits.

Nearly all immature mandibulate insects have demonstrated some sensitivity to diflubenzuron, including Orthoptera (grasshoppers, crickets, walkingsticks) and Tenthredinoidea (Willcox and Coffey 1978; Maas 1980; Blumberg 1986). Mesostigmata Orbatei and Prostigmata acarines (mites) were adversely affected and did not recover to pretreatment levels (Blumberg 1986) at a rate of 2 oz. of active ingredient per acre. Normal gypsy moth suppression applications are .03 lb. of active ingredient per acre. No obvious short term trends in populations of other organisms captured by Blumberg could be attributed to application of diflubenzuron. Immature <u>Apanteles</u> <u>melanoscelus</u> (Ratzeburg) (a braconid) and Tachinids (flies) developing within treated caterpillars are susceptible to applications of diflubenzuron (Madrid and Stewart 1981). Adult parasites are not seriously affected regardless of the method of exposure to rates of diflubenzuron.

Endangered, Threatened and Sensitive Species

Effects of implementing alternative 3 on endangered and threatened species would be similar to effects of alternative 2 except for diflubenzuron. Organisms that produce chitin will potentially be affected during periods when diflubenzuron is available for uptake (Willcox and Coffey 1978). Species such as the regal fritillary (table III-4) may be susceptible to applications of diflubenzuron and may experience population reduction during treatment years. Indications are that some crustaceans, including several cave isopods and amphipids, may be vulnerable to applications of Dimilin (appendix B).

Diflubenzuron may later reduce populations of a few night-flying insects (primarily macrolepidopterans) which are utilized as food source by Virginia bid-eared bat, Indiana bat, Keen's myotis, small-footed bat and Rafinesque's big-eared bat. Such a reduction would be temporary in the treated area.

Fish and Aquatic Ecosystems

Impacts of alternative 3 on fish and other aquatic organisms will be similar to those described for alternative 2 except for treatments with diflubenzuron. Diflubenzuron is non-toxic to fish (Willcox, Coffey 1978); it is not accumulated by, and does not increase mortality of fish species studied by Kingsbury (1987). Effects on invertebrate fauna as a source of food for fish are thought to be insignificant in a stream investigated by Jones (1987). Diflubenzuron has been found to reduce populations of certain sensitive non-target crustaceans, primarily water fleas, cyclops and immature copepods as well as certain species of aquatic insects (mayflies, corixids and notonectids) (Willcox and Coffey, 1978). The effect of diflubenzuron is extremely variable, is non-persistent in the environment and population recovery of the more sensitive species occurs within 14 to 28 days in most cases (Willcox and Coffey, 1978); however, no short-term population trends were evident in aquatic invertebrates investigated by Blumberg in 1986, and populations of even the most severely affected organisms were well-established three months after treatment (Kingsbury 1987).

Soil

None of the intervention tactics in this alternative are likely to have an effect on the soil or litter in selected project areas. Diflubenzuron is rapidly degraded in about three to four days once it gets into the soil. This rapid degradation is unrelated to soil type, but very much related to microbial activity. Studies have shown that 111 types of soil bacteria can utilize diflubenzuron as a sole carbon or sole carbon and nitrogen source (Willcox and Coffey, 1978). No indirect or cumulative affect on soil or litter is anticipated from implementation of this alternative.

Water Quality

The addition of diflubenzuron to this alternative, along with the gypsy moth specific and biological tactics, is not expected to affect water quality. The persistence of diflubenzuron in water is a function of microbial activity, pH, temperature and suspended organic matter and is generally short term with a half life of less than 24 hours (Willcox and Coffey, 1978). No indirect or cumulative impacts on water quality is anticipated with implementation of this alternative.

Air Quality

No significant direct, indirect or cumulative impacts on air quality would be anticipated from any of the intervention tactics proposed in this alternative.

Visual Resource

Visual and scenic values, depending on the intervention tactic used, should be maintained at their current levels within the General Project Area. Some light defoliation may occur in areas where the inherited sterility technique is implemented. No major indirect or cumulative effects on visual resource as discussed under alternative 1 are anticipated from implementing this alternative.

Recreation

This alternative should help maintain recreational use at or near current levels in high-value parks, recreation areas and commercial campgrounds within the General Project Area. Some temporary decline in use may result if parks or recreation areas are closed during treatment operations. Other visitors or users may choose to avoid areas treated with diflubenzuron, but residues of this insecticide on objects, such as picnic tables, will degrade to non-detectable levels in about one week (Cameron and others 1985).

The effect of this alternative on dispersed recreation would be minimal. Foliage should be maintained in most of the areas treated. Visitors involved in hiking, fishing, hunting, viewing scenery, or other activities would probably be unable to distinguish treatment areas.

No indirect or cumulative impacts on developed or dispersed recreation is anticipated from implementation of this alternative, and the impacts described in alternative 1 would generally be prevented.

Cultural and Historical Resources

No effects on the cultural and historical resources are anticipated under this alternative.

Public Health

Under this alternative, the potential impact of the gypsy moth specific and biological tactics on human health are the same as those discussed in alternative 2. The addition of diflubenzuron to this alternative and its potential effects on public health are discussed in detail in the USDA FEIS 1985. The updated risk assessment for using diflubenzuron from this 1985 document is contained in appendix C of this EIS. Diflubenzuron is an insect growth regulator which interferes with the synthesis of chitin, a substance found in the body wall of insects. Chitin synthesis does not occur in higher organisms; therefore, diflubenzuron has very low mammalian and nonmammalian toxicity exclusive of insects and some aquatic organisms. The acceptable daily intake (ADI) has been set by the Environmental Protection Agency (EPA) at 0.02 mg/kg/day for humans. All possible exposures to the general public are below the ADI.

The toxicity of a chemical is measured by feeding the compound to a population of laboratory animals. The concentration of the chemical that gives a lethal dose to 50 percent of the population of test animals is called the oral LD_{50}. The

Table IV-2.--Toxicity of diflubenzuron and common chemicals

Toxicity Category	Chemical Substance	Oral LD_{50} (rats: mg/kg)
Very slight	Alcohol (ethyl)	13,700
Slight	Diflubenzuron	>4,640
	Table salt	3,750
	Aspirin	1,700
Moderate	Caffeine	200
Severe	Nicotine	50

Source: Walstad and Dost, 1984

smaller the oral LD_{50} concentration, the more toxic is the chemical. Although the LD_{50} of diflubenzuron is unknown, the highest dose tested puts it in the slight toxicity category, along with several household chemicals displayed in table IV-2 (Walstad and Dost 1984).

Chronic Toxicity. The major toxic effect observed in test subjects upon exposure to diflubenzuron is the formation of sulfhemoglobin and methemoglobin pigments in the circulatory system. Hemoglobin in its nonoxidized state is essential for the transport of oxygen, whereas the oxidized form, methemoglobin, plays no role in oxygen transport. Investigators have suggested that there is a correlation between increased levels of methemoglobin and increased levels of sulfhemoglobin.

An 80-week mouse feeding study established a NOEL of 1.1 mg/kg/day based on the formation of methemoglobin and sulfhemoglobin in the test animals (USEPA, 1984c). A 104-week rat feeding study resulted in a NOEL of 40 ppm (2 mg/kg/day) with increased levels of methemoglobin and sulfhemoglobin observed in test animals (USEPA, 1984c). A lifetime oncogenic mouse feeding study also established a NOEL of 16 ppm (2.4 mg/kg/day) based on increased levels of methemoglobin and sulfhemoglobin (USEPA, 1984c).

Teratogenicity and Reproduction. Teratology studies in rats and mice did not result in teratogenic effects at the levels tested (USEPA, 1984c). Maternal toxicity, fetal toxicity, and teratogenic NOELS were established as being greater than 4,000 mg/kg/day (highest dose tested) for both test species (USEPA, 1984c). A three-generation rat reproduction study resulted in no reproductive toxic effects at 10, 20, 40 and 160 ppm (0.5, 1, 2, and 8 mg/kg/day) (USEPA, 1984c; Uniroyal, 1983).

Mutagenicity. Diflubenzuron was found to be nonmutagenic even at high doses (Quarles et al., 1980; MacGregor et al., 1979; and USEPA, 1984c). Concentrations of 500 mg/kg body weight did not produce a mutagenic response in hamster fetal cells (Quarles et al., 1980). Negative results also were obtained for diflubenzuron in the mouse micronucleus test in vivo, the mouse lymphoma mutation assay, and the bacterial Ames mutation assay (MacGregor et al., 1979).

Oncogenicity. No evidence of oncogenicity was observed in any test animals at doses as high as 1,000 ppm (150 mg/kg/day) in the lifetime oncogenic mouse study (USEPA,

1984c). A second oncogenic study that used rats also produced no oncogenic effects even at 10,000 ppm (500 mg/kg/day) (highest dose tested) (USEPA, 1984c). Although diflubenzuron has not been shown to be carcinogenic, one of its metabolic breakdown products, 4-chloroaniline, has been claimed to be a carcinogen. This possibility is discussed in Appendix C in the section on cancer potencies.

Socio-economic Effects

This alternative, like alternative 2, would reduce the socio-economic effects as described under alternative 1. Although some salvage may occur, the adverse effects on local and regional markets would be reduced. Near normal timber growth and removals should continue throughout the area.

Prime Farmland and Rangeland

Alternative 3 will have no direct effects on prime farmland or rangeland since this is not the habitat of the gypsy moth. It is possible that during the treatment of adjacent infested forest stands that farm or rangeland may receive minor amounts of insecticides due to drift. In the case of diflubenzuron, as with all insecticides, mitigation measures will be implemented to minimize or prevent insecticide drift into these non-target areas. In those cases where minor drift does occur despite mitigation measures employed, all levels encountered on food crops would be below the ADI (Acceptable Daily Intake) set for diflubenzuron (appendix C). Any diflubenzuron ingested by domestic range animals would have no adverse effects and would be quickly excreted by the animals (Willcox and Coffey 1978). No additional, significant indirect or cumulative effects are anticipated with implementation of this alternative.

Wetlands and Flood Plains

AIPM intervention tactics will not physically impact or alter wetlands and flood plains.

Consumers, Civil Rights, Minority Groups and Women

None of these groups are likely to be impacted or affected by implementation of this alternative directly, indirectly or cumulatively.

Wilderness

Same as alternative 2.

ALTERNATIVE 4

For the General Project Area, alternative 4 contains the same intervention components as alternative 3. Therefore, the estimated direct, indirect and cumulative effects of implementing this alternative would be the same as those discussed in alternative 3.

In wilderness, gypsy moth-specific tactics could be used.

Natural Integrity

The existing wilderness environment would be directly affected by gypsy moth intervention tactics and would reflect human influences rather than natural processes.

The direct, indirect and cumulative impacts of this alternative will be to perpetuate the existing wilderness ecosystem as long as intervention tactics are continued and are successful.

Apparent Naturalness

Apparent naturalness would be enhanced under this alternative. Intervention would preserve existing vegetation, wildlife, soil and water quality.

The application of intervention tactics would not be readily apparent to wilderness users in the case of aerial application of NPV or disparlure flakes except during the application process. Aircraft and ground support personnel affect apparent naturalness during time of application.

The indirect and cumulative effects of this alternative would not be readily apparent. As long as intervention tactics were effective, the existing ecosystem would reflect the apparent natural conditions that occur now.

Opportunities for Primitive Recreation

This alternative would not significantly impact the opportunities for primitive recreation experiences. These existing opportunities would be preserved from the impacts of gypsy moth. However, during periods of intervention, visitors may choose not to use the wilderness because of the intervention tactics applied there, and thus the opportunity to participate in these kinds of wilderness experiences would be lost to them. These impacts will be temporary, during the spring when intervention tactics are applied.

Opportunities for Solitude

Alternative 4 should perpetuate this attribute if intervention protects the existing vegetative screening. The physical attributes which provide for solitude should not be significantly changed. Aerial applications of NPV and disparlure flakes would impact this wilderness attribute only when the application process takes place.

No indirect or cumulative impacts to the opportunities for solitude are associated with this alternative.

Supplemental Attributes

The effect of this alternative would be to maintain the number and size of old growth trees in wilderness. Natural processes in the absence of gypsy moth would allow a mix of old growth trees and young trees to become established. There should be no impact to other geological, cultural, historical or ecological features.

The scientific value of wilderness as a base line area would be diminished. Wilderness will reflect man's intervention tactics on gypsy moth, instead of how nature reacts to the pest.

Scenic Values

Treated areas should preserve existing scenic values associated with wilderness and characteristics of the existing landscape. Some defoliation and mortality would be expected to occur under this alternative, but would be considered insignificant.

The indirect and cumulative effects of this alternative would retain existing scenic values.

ALTERNATIVE 5

For the General Project Area, alternative 5 contains the same intervention components as alternatives 3 and 4; therefore, the estimated direct, indirect and cumulative effects of implementing this alternative would be the same as those presented in alternatives 3 and 4. In wilderness, gypsy moth-specific tactics and biological tactics could be used.

Wilderness

Natural Integrity

The direct effects on natural integrity would be similar as those in alternative 4, but additional impacts would occur with the use of the biological insecticide Bt. It can be expected that lesser amounts of defoliation and tree mortality would occur due to reduced population levels of gypsy moth. However, Bt has been shown to adversely affect some nontarget organisms, such as other Lepidoptera species.

It can be concluded that Bt can reduce, at least temporarily, the population levels of non-target Lepidoptera species.

The direct, indirect and cumulative effects of implementing this alternative upon the wilderness ecosystem would reflect human influences and reduce the population of nontarget Lepidoptera species of the area. Repeated applications of Bt through successive years could directly impact native Lepidoptera and possibly alter their ecological role in the wilderness environment. Further reductions in the amount of defoliation and tree mortality, however, would occur under this alternative.

Remaining Attributes

The types of direct, indirect and cumulative effects on these attributes would be the same as in alternative 4.

ALTERNATIVE 6

For the General Project Area, alternative 6 contains the same intervention components as alternatives 3, 4 and 5; therefore, the estimated direct, indirect and cumulative effects of implementing this alternative would be the same as those presented in alternatives 3, 4 and 5. In wilderness, gypsy moth-specific, biological and diflubenzuron tactics could be used.

Wilderness

Natural Integrity

The direct effects on natural integrity would be similar to those in alternative 4 and 5, but additional impacts would occur with the use of the chemical growth regulator diflubenzuron. It can be expected that lesser amounts of defoliation and tree mortality would occur due to reduced population levels of gypsy moth. However, diflubenzuron has been shown to adversely affect some nontarget organisms such as canopy leaf-eating insects, crustaceans, water fleas, cyclops, copeods and certain species of aquatic insects (mayflies, corixids, and notonectids), (USDA FEIS 1985). It can be concluded that diflubenzuron may reduce the diversity of nontarget insects in the wilderness environment.

The direct, indirect and cumulative effects of implementing this alternative upon the wilderness ecosystem would reflect human influences and reduce the biological diversity of the area. Repeated applications of diflubenzuron through successive years could directly impact native non-target organisms that are susceptible to this chemical growth regulator and possibly alter their ecological role in the wilderness environment. Further reductions in the amount of defoliation and tree mortality, however, would occur under this alternative.

Remaining Attributes

The types of direct, indirect and cumulative effects on these attributes would be the same as under alternatives 4 and 5.

RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Short-term uses are those activities that generally occur on a yearly basis or will not be significant beyond the 5-year program. Long-term productivity are those actions or activities that have an effect or influence beyond this time frame.

The National Forest Management Act, Forest and Rangeland Renewable Resources Planning Act and Multiple Use Sustained Yield Act dictate that national forests must be managed to protect long-term productivity of the land. Other laws require that National Park lands be managed in such a manner that will leave them unimpaired for the enjoyment of future generations.

Most management decisions and resource outputs are by nature short-term but may affect maintenance of long-term productivity. Generally, management requirements and mitigating measures reduce or eliminate potential effects on long-term productivity by protecting resources like soil, water, wildlife, threatened and endangered plants and animals, and visual quality.

Monitoring requirements which apply to all alternatives ensure that long-term productivity is not impaired by short-term uses or activities. If monitoring discloses that management requirements and mitigation measures are inadequate, new ones will be developed and implemented.

Vegetation

Alternative 1 (no action) would have the greatest impact on the forested resources over time. As the gypsy moth spreads into and through the AIPM Project Area, susceptible trees will be killed. Mortality in some stands will be heavy and may

occur over large areas. The resulting losses would include both current production and future growing stock of desired forest species. Less susceptible gypsy moth tree species, however, will gradually replace the susceptible oaks as the future growing stock of the area. These species will eventually become the dominant forest type and will affect timber management activities and decisions.

Alternatives 2 to 6 would permit intervention to minimize or reduce impacts on short-term productivity. Impacts on long-term productivity may not be minimized, since the AIPM Project is scheduled to run 5 years, and the level of intervention cannot be predicted beyond that period. However, one of the goals of the project is to identify intervention tactics that could be implemented further into the future to reduce impacts on long-term productivity.

Soil

Alternatives 2 through 6 would permit intervention which would reduce gypsy moth-caused defoliation and associated hardwood mortality. None of the intervention tactics would directly affect soil productivity in either the short- or long-term period. Reduced tree mortality would minimize the need for timber salvage operations.

Water Quality

None of the alternatives involve short-term uses or water that would affect long-term productivity. There may be some short-term effects on water quality under all alternatives due to defoliation and increases in water yields. The potential for increases in water yields are most likely under alternative 1 because there would be greater acreages of untreated forested areas. However, increased water yields may also occur if treatment is ineffective under alternatives 2-6. Long-term effects are not anticipated under any of the alternatives, as the defoliated areas will regenerate and water yields will return to predefoliated levels.

Recreation

Alternative 1 (no action) would create the greatest potential for reduced recreation use in the short term. Uncontrolled gypsy moth populations in developed recreation areas would result in increased defoliation and insect nuisance. In the long term, this alternative would have no significant impacts on visitor use.

Alternatives 2 through 6 would prevent or minimize the reduction in visitor use in the short term and have no significant impacts on the long term recreationalopportunities.

Socio-economic Effects

Timber mortality and salvage operations associated with alternative 1 may increase the supply of timber available in local markets. If the supply exceeds demand, stumpage prices will decline, reducing the income timber owners or managers receive in the short term. The production of high quality oak products may decrease in the long term, but the production of less gypsy moth-susceptible pine and hardwood timber would allow long-term productivity to be maintained.

Alternatives 2 through 6 would tend to minimize the effects associated with alternative 1 in the short term by preventing much of the hardwood mortality and salvage operations. This will help maintain stable timber markets and associated

incomes at current levels. If appropriate intervention methods continue into the future, long-term socio-economic impacts should also be minimized.

RELATIONSHIP TO PLANS OF OTHER AGENCIES

Chapter VII of this document identified agencies that were contacted during the scoping process to inform them of the AIPM Project and how it may be coordinated with their respective plans. As cooperating partners, the Forest Service, National Park Service, Virginia Department of Agriculture and Consumer Services and West Virginia Department of Agriculture have been a continuing part of the project's conception and development. Additional agencies have provided information in the preparation of this environmental impact statement:

- Fish and Wildlife Service has assisted with data and requirements for compliance with the Endangered Species Act;

- Animal and Plant Health Inspection Service has assisted with information on the inherited sterility tactic and planned additional developmental work on this tactic in areas of the AIPM Project:

- Pennsylvania Game Commission assisted with information on gypsy impacts on game species;

- Finally, Chapter VII contains a list of other agencies which will review this document.

No apparent conflicts with other agency plans have been noted. However, during the public review period of this document, the possibility of conflict between implementation of the AIPM Program and other agency missions and objectives could arise. Resolution of these conflicts can occur through amending the agency's plan (as in the case of National Forest Land and Resource Management Plans), the intervention tactic chosen or by exercising the option of not participating in the AIPM program.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible Commitments

Irreversible commitments of resources result in the loss of future options. It pertains primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over long periods of time. It is doubtful that any irreversible commitments of resources would occur as a result of selecting an alternative in this AIPM Program EIS. The irreversible commitments of resources may occur at the project level and will be identified in the site-specific analysis.

The potential irreversible commitments of resources that could occur at the project level are:

Wilderness

If no action is taken, the gypsy moth infestation in wilderness could create an immediate and future condition due to an exotic insect introduced by man. This nonaction commitment of the wilderness resource is irreversible.

If action is taken to manage the gypsy moth in wilderness, man's actions would irreversibly alter the wilderness resource.

Irretrievable Commitments

Irretrievable commitments of resources pertain to loss of production, harvest, or use of natural resources. For example, some or all of the habitat required by sensitive wildlife species needing a remote, quiet environment is lost irretrievably while an area is serving as a winter sports site. The production or use of the area to support such wildlife is irretrievable, but the action is not irreversible. If the use changes, it is possible for the area to resume its original condition favorable to production of remote wildlife species. It is doubtful that the selection of an alternative for the AIPM Program will cause any irretrievable commitments of resources. Irretrievable commitments of resources could occur at the project level if action is taken. These irretrievable commitments will be identified in the site-specific analysis.

The potential irreversible commitments of resources that could occur at the project level are:

Socio-economic

If gypsy moth is not managed, merchantable timber killed by gypsy moth and not salvaged, and the decrease in log value for salvage timber, as opposed to live timber, represents an irretrievable loss. Tree mortality is expected to be greater under a no action alternative than under other alternatives that include intervention tactics. Therefore, the irretrievable loss of timber value will likely be greater when gypsy moth is not managed. Differences in timber loss between the other alternatives cannot be predicted.

Vegetation and Wildlife

Gypsy moth will also feed on non-merchantable vegetation. The resulting changes in the habitat will have impacts, either directly or indirectly, on wildlife. Loss of wildlife due to mortality and relocation, and decreases in reproduction represent an irretrievable commitment of the wildlife resource. Impacts to vegetation and resulting impacts to wildlife are expected to be greater initially if gypsy moth is not managed.

Recreation and Visual Resources

Loss of high quality recreational opportunity and visual resources will be greater for areas infested with gypsy moth that are not treated. These losses represent irretrievable commitments of resources that will be greater if gypsy moth is not managed. Differences in recreation opportunity and scenic value loss cannot be predicted.

Other Resource Commitments

Labor, material, and dollars committed to implementation of an alternative that otherwise would have been available for investment elsewhere are irretrievable. Opportunity to use these resources for another purpose is foregone. This irretrievable opportunity is greater if action is taken than if it is not.

Energy expended in implementation of an alternative is an irreversible commitment of resources. No action would expend less energy than taking action.

PROBABLE ADVERSE ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED

Adverse environmental effects are unavoidable despite mitigation measures in all of the alternatives. Some effects are related to alternative 1, only while others are produced where gypsy moth intervention activities occur. These effects are:

Vegetation

Tree mortality associated with defoliation by gypsy moth could occur in susceptible stands. In heavily defoliated areas, long-term effects would be a change in forest tree species from susceptible oaks to other less gypsy moth susceptible species.

Wildlife and Wildlife Habitat

In areas where gypsy moth is allowed to run its natural course, changes in wildlife habitat will produce changes in wildlife abundance, distribution and animal community composition.

Insects

Insects will be impacted under all alternatives. Gypsy moth larvae will compete with native insects that utilize the same food source. Displacement of these native species would occur. Insecticide use would affect the population of susceptible non-target organisms when used as an intervention method on gypsy moth (alternatives 2 through 6).

Endangered, Threatened and Sensitive Species

Potential adverse effects associated with gypsy moth defoliations would occur if a no treatment prescription is selected for sites that support populations of Virginia northern flying squirrel, Virginia big-eared bat, Indiana bat, bald eagle, cheat mountain salamander, Shenandoah salamander, Madison Cave isopod, swamp pink, running buffalo clover, shale barren rockcress or harparella.

Potential adverse effects associated with applications of Bt would occur if prescriptions containing treatments with Bt are selected for sites that support populations of Virginia big-eared bat, or Indiana bat.

Potential adverse effects associated with diflubenzuron would occur if prescriptions containing treatments with diflubenzuron are selected for sites that support populations of Virginia big-eared bat or Indiana bat.

Water

Water quality will be affected during periods of heavy rain. The taste, odor and color of water will be altered by accumulations of insect larvae, frass and leaf parts into small streams in heavily defoliated areas.

Visual Resource

Visual quality is impaired when defoliation by gypsy moth occurs.

Recreation

Insecticide use will lower the visitor use during time of application in developed sites. Untreated areas will also have lower use rates due to the nuisance problems created by gypsy moth. Heavy mortality of trees in developed sites will produce undesirable effects on the recreational experience due to hazardous trees and denial of the forest environment expected by the user.

Socio-Economic Conditions

Alternative 1 will have the greatest impact on this resource. Local timber markets will be affected if extensive mortality occurs. Significant reductions in the rate of return from forest investment will alter forest management practices and the prominence of forest-related economics.

Wilderness

Wilderness attributes will be impacted from gypsy moth (an exotic insect) and by intervention activities employed against the gypsy moth.

IDENTIFIED RESEARCH NEEDS

No critical data gaps or missing information was identified that would prevent the implementation of any alternative discussed in this EIS. Where noncritical information needs were identified, this information was added to the following research needs list. It is anticipated that in the course of the AIPM Project that funds will be provided to address the various items contained in this list:

1. Determine the most effective overflooding ratios of the F1 inherited sterility technique for use in areas adjacent to the generally infested area.

2. Develop a more competitive strain of gypsy moth for use in the inherited sterility technique.

3. Improve the NPV formulation to increase the efficacy against all gypsy moth population levels.

4. Determine the effects of Bt and diflubenzuron on macro Lepidoptera in eastern hardwood forests.

5. Determine the effects of Bt and diflubenzuron on susceptible endangered and threatened species.

6. Determine the relationship of male moth captures (trap catches) to other life stages.

7. Determine the field effective dose of disparlure tape of flakes to achieve mating disruption.

8. Improve field-residue monitoring techniques for all three insecticides.

9. Determine effects of Bt and diflubenzuron applications on food supplies of bats and songbird nestlings.

10. Determine the effects of gypsy moth defoliation on native leaf-eating insects.

11. Determine the effects of gypsy moth defoliation on habitat and food supplies for

    a. Game species (including fish);

    b. Endangered or threatened species;

    c. Aquatic organisms.

LIST OF PREPARERS

CHAPTER V

CHAPTER V

LIST OF PREPARERS

AIPM Project Interdisciplinary Team

The project interdisciplinary (ID) team members listed below were responsible for integrating knowledge of the physical, biological, economic and social sciences for this EIS. Team members were responsible for identifying and analyzing issues, developing options for issue resolution and alternative actions, analyzing public comments and preparing responses. (Further interdisciplinary functions are described in 36 CFR 219.6).

Core ID Team Members

Name: David P. Smith

Position: Team Leader, AIPM EIS Team, USDA Forest Service, Southern Region Forest Pest Management, Atlanta, GA 30367.

Experience and Education: Twelve years service in positions involving timber management, silviculture, recreation and other forest resources. Assignments were on Forests in South Carolina, Mississippi, Illinois and Regional Office in Atlanta, Georgia. Served as Team member and Team Leader that prepared the EIS for Suppression of the Southern Pine Beetle-Southern Region. From 1973 to 1976, served as a park planner with the Maryland Department of Natural Resources, Annapolis, MD. Certified silviculturist in Southern Region. Holds B.S. in Forestry from Southern Illinois University, Carbondale, IL.

EIS Responsibility: Team Leader for interdisciplinary team preparing the EIS.

Name: John H. Ghent

Position: Entomologist, USDA Forest Service, Southern Region, Forest Pest Management, Asheville, NC 28804.

Experience and education: In current position since 1976. Twelve years experience with USDA Forest Service. Holds a B.S. in biology from Catawba College, Salisbury, NC and M.F. in forest protection from Duke University, Durham, NC.

EIS Responsibility: Wrote updated Risk Analysis for diflubenzuron. Provided technical input and review on toxicological information for insecticides.

Name: John W. Hazel

Position: Forester, USDA Forest Service, Eastern Region, Milwaukee, WI. 53203.

Experience and education: Thirteen years with USDA Forest Service in positions involving forest administration, forest planning, wild & scenic rivers, timber management, human resources, silviculture, and other forest resources. Duty assignments were on National Forests in Texas, Ohio, West Virginia and Regional Office in Milwaukee, WI. Received BSF, West Virginia University, 1971. R9 Continuing Education Program, 1982.

EIS Responsibility: Major participant in development and compilation of EIS.

Name: Gary M. Peters

Position: Wildlife Biologist, USDA Forest Service, Wayne-Hoosier National Forest, Bedford, Indiana 47421.

Experience and education: Twelve years with the USDA Forest Service in positions including fish and wildlife, endangered and threatened species, special areas, timber management, land management planning, cultural resources and pesticide administration responsibilities. Currently in continuing education program for wildlife biologists, A.A.S. Wildlife Management, Hocking Technical College 1975, B.S. Public Affairs/Environmental Science, Indiana University 1983.

EIS responsibility: Evaluate effects of gypsy moth and AIPM Project on fish and wildlife, endangered and threatened species and insects. Contribute to the development, compilation and presentation of the EIS.

Name: John C. Romanowski

Position: Forester, AIPM EIS Team, USDA Forest Service, Southern Region, Forest Pest Management, Atlanta, GA,30367.

Experience and education: Ten years service with the USDA Forest Service involving positions in wilderness, recreation, other forest resources and watershed management. Assignments were on National Forests in Georgia, Virginia and Mississippi. Holds a B.S. degree in Forest Management, University of Vermont, Burlington, VT.

EIS Responsibility: Major participant in development and compilation of EIS. Evaluated the effects of gypsy moth and gypsy moth intervention alternatives on wilderness characteristics and values.

Name: Robert D. Wolfe

Position: Staff Pathologist, USDA Forest Service, State and Private Forestry, Forest Pest Management, Broomall, PA 19008.

Experience and education: In present position since 1976. Twenty-four years employment with the USDA Forest Service. Previous assignments were at Macon, GA, Alexanderia, LA, and Asheville, NC. Holds a BS degree in Biology and a MF in Forest Pathology from Duke University, Durham, NC.

EIS Responsibility: Major participant in development and compilation of EIS.

Staff Support

Name: Saranel Winkler

Position: Program Assistant, AIPM EIS Team, USDA Forest Service, Southern Region Forest Pest Management, Atlanta, GA 30367.

Nineteen years experience with Forest Service involving positions in State & Private Forestry, Fiscal, Recreation, Engineering, and most recently worked with the interdisciplinary team in preparation of the Southern Pine Beetle Environmental Impact Statement.

PUBLIC PARTICIPATION AND CONSULTATION WITH OTHERS

CHAPTER VI

PUBLIC PARTICIPATION AND CONSULTATION WITH OTHERS

A. Public Involvement Summary

The Forest Service has encouraged public participation throughout this EIS preparation. Steps taken to keep the public informed and involved are:

Notice of Intent - A notice of intent to prepare this EIS was published in the March 10, 1988 Federal Register. This notice invited public comment and suggestions to help determine the issues and sub-issues to be addressed in the EIS.

Letter to the Public - The public was asked to identify issues through the use of a post paid mailer sent in March, 1988. Approximately 3,000 of these mailers were distributed to interested individuals and organizations who have expressed interest in management of the National Forests in the AIPM Project area as well as the Shenandoah National Park. These individuals and organizations were obtained from lists kept by the National Park and National Forests and merged into a master list to obtain the broadest possible coverage.

Media - A press release by the Regional Public Affairs Office was distributed to regional media and to local media by individual Forest Public Affairs Offices in March, 1988.

Responses - Public responses to the request for comments and suggestions on issues were placed into 7 categories:

1. Elected Officials
2. Local Government
3. State Government
4. Federal Government
5. Individuals
6. Interest Groups
7. Educational Groups

A total of 312 responses to the scoping request were received and used to develop the issues to be addressed in the EIS.

Responses were organized into a dozen or so groups based on methods and resources affected. These groups were analyzed for major themes and condensed into major issues (Chapter 1). The alternatives and mitigating measures were developed to respond to these issues.

A monthly newsletter was developed (Appalachian Gypsy Moth IPM Demonstration Project News) to report on the progress and results of the AIPM project. The July newsletter (Volume 1, Issue 3) specifically discussed the EIS process.

On August 20,1988, a presentation on the AIPM project and EIS process was made to the Appalachian Regional Conservation Committee of the Sierra Club. This presentation was requested by the club so that input could be developed and sent to the EIS Team.

B. Technical Advisors and Reviewers

Allan Bullard	USDA Forest Service
Charles Cartwright	USDA Forest Service
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William Gillespie	West Virginia Department of Agriculture
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Richard Reardon	USDA Forest Service
Ken Swain	USDA Forest Service
Harvey Toko	USDA Forest Service
J. W. Wade	USDI National Park Service

C. Consultation with Others

One of the most important parts of the process of preparing this environmental impact statement is information gathering. Advice and contributions from experts are essential for a thorough and complete analysis. The following individuals contributed to this analysis:

Bob Acciavatti	USDA Forest Service
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D. List of Those to Whom This Document was Sent

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GLOSSARY

CHAPTER VII

GLOSSARY

Acceptable daily intake (ADI).--The maximum dose of a substance that is anticipated to be without lifetime risk to humans when taken daily.

Active ingredient (a.i.).--The effective part of a pesticide formulation, or the actual amount of the technical material present in the formulation.

Acute toxicity.--The toxicity of a compound when given in a single dose or in multiple doses over a period of 24 hours or less.

Administrative unit.--All the National Forest System lands for which one forest supervisor has responsibility.

Affected environment.--The environment of the area(s) to be affected or created by the alternatives under consideration in the EIS.

Air quality.--The composition of air with respect to the quantities of pollutants. Most frequently used in connection with standards of maximum acceptable pollutant concentrations.

Alternative.--A proposition or situation offering a choice between two or more management methods, only one of which may be chosen.

Amellaria mellea.--A naturally occurring fungus, the shoestring fungus, normally acting as a secondary pathogen, that becomes a primary pathological agent in trees weakened by drought or other stresses such as defoliation. This pathogen is the agent responsible for a great deal of tree mortality in areas that have been defoliated by gypsy moth.

Amphibians.--A class of animals including frogs and salamanders that begin life in water, breathing through gills, but later develop lungs. As adults, they breathe air but are found in or near water.

Anticline.--A sharply arched fold of stratified rock. The strata slope downward in opposite directions from the center, or highest point (see also: syncline).

APHIS.--Animal and Plant Health Inspection Service. The USDA agency responsible for regulating mateirals which have potential for artificially moving gypsy moth out of quarantined areas and for eradicating isolated infestations of gypsy moth.

Apparent naturalness.--The perception and value placed upon impacts and activities on the wilderness resource as percieved by wilderness visitors. Closely related to natural integrity.

Arthropods.--Major group of invertebrate animals belonging to the phylum Arthropoda. This group includes insects, spiders and crustaceans.

Augmentation.--Encouragement or artificial introduction of an established species of parasite or predator that dramatically increases the number of these animals present in an area.

Bacillus thuringiensis.--Scientific name of a bacterium that is pathogenic to the larval stage of many lepidopterous insects. The active ingredient in biological insecticides old under such names as Dipel[R], Bactospeine[R] and Thuricide[R].

Biological evaluation.--1) The gathering, analysis, and interpretation of technical data from an entomological standpoint to provide a sound base for making pest management decisions, 2) the term for an analysis process used to determine if a proposed action "may affect" an endangered or threatened species or, to determine effects of a proposed action on sensitive species.

Biosynthesis.--The use of living organisms to produce chemical compounds.

Canopy.--The cover of branches and foliage formed collectively by the crowns of adjacent trees and other woody growth.

Category 1 Species.--Species identified by the USDI Fish and Wildlife Service for which known information supports the appropriateness to propose to list them as Endangered or Threatened.

Carcinogenicity.--Tendency of a substance to cause cancer.

Chitin.--A semi-transparent horny substance forming the principal component of crustacean shells, insect exoskeletons and the cell walls of certain fungi.

Class I area.--One of three classes of areas provided for in the Clean Air Act for the Prevention of Significant Deterioration program. Class I areas are the "cleanest" area and receive special visibility protection. They are allowed very limited increases (increments) in sulfur dioxide and particulate matter concentrations in the ambient air over baseline concentrations. (See 42 U.S.C. 7473 for description of the specific increments).

Clearcutting.--The harvesting, in one cut, of all trees in an area for the purpose of creating a new, even-aged stand. The area harvested may be a patch, stand, or strip large enough to be mapped or recorded as a separate age class.

Code of Federal Regulations (CFR).--The Code of Federal Regulations is a codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government. The Code is divided into 50 titles which represent broad areas subject to Federal regulations. Each title is divided into chapters which usually bear the name of the issuing agency. Each chapter is further subdivided into parts covering specific regulatory areas.

The Code of Federal Regulations is kept up to date by the individual issues of the Federal Register. These two publications must be used together to determine the latest version of any given rule.

Colluvial.--An area where loose rock fragments, sand, etc, accumulate, such as at the bottom of slopes.

Commercial forest land.--Forest land which is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as commercial timberland have the capability of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands. Currently, inaccessible and inoperable areas are included.)

Commercial thinning.--Cutting by means of sales for products (poles, posts, pulpwood, etc.) in immature stands to improve the quality and growth of the remaining stand.

Concern.--See "management concern."

Conservation of Endangered Species.--Efforts undertaken to bring a population of an endangered plant or animal to the point where continued existence of a species is no longer in question.

Cultural resources.--The physical remains (artifacts, ruins, burial mounds, petroglyphs, etc.) and conceptual content or context of an area (such as a setting for legendary, historic, or prehistoric events, as a sacred area of native peoples) which is useful or important for making land-use planning decisions.

Decline phase.--The phase of the gypsy moth cycle following outbreak when populations are falling off to innocuous levels (see also: innoucuous phase, outbreak phase, release phase).

Defoliation innocuous mode.--The phase of the gypsy moth cycle during which insects are present in the area but at extremely low levels. Widespread, visible defoliation does not occur during this phase.

Delimiting traps.--Adult male gypsy moth traps set out in close grid formation to determine the geographic extent of a particular population. This approach is usually used by APHIS to determine the extent of an isolated infestation.

Developed recreation.--Use of a fairly small, distinctly defined area where facilities are provided for concentrated public use -- campgrounds, picnic areas, swimming areas, etc.

Diflubenzuron.--The active ingredient of insecticide formulations sold under the trade name Dimilin. Acts as a growth regulator by interfering with chitin synthesis and prevents gypsy moth from successfully completing their molting phases.

Disparlure.--Commercially synthesized female gypsy moth sex pheromone. Disparlure is used to disrupt mating by making it difficult for male moths to locate female moths.

Dispersed recreation.--That portion of forest and rangeland used for recreation outside of developed sites. Examples include scenic driving, hunting and backpacking.

Diversity.--The variety, distribution and abundance of different plants and animals.

Dosage rate.--Quantity of a toxicant applied per unit area. Usually expressed as oz. or lbs. active ingredient per acre.

Draft environmental impact statement (DEIS).--A detailed, written statement of effects required for major Federal actions under Section 102(2)(c) of the National Environmental Policy Act and released to the public and other agencies for review and comment.

Early forest succession.--Those plant communities that occupy an area immediately following the removal or destruction of the vegetation in an area.

Ecosystem.--The system formed by the interaction of a group of organisms and their environment.

Edge.--The more or less well-defined boundary between two or more elements of the environment. For example, field/woodland.

Effects.--Include: 1) direct effects, which are caused by the action and occur at the same time and place, 2) indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. 3) cumulative effects, which are the result of activities occurring in many places at the same time or, activites occurring repeatedly in the same place over time. Effects and impacts are synonymous.

Egg masses.--Gypsy moth eggs, deposited in groups of 100 to 1,000 in tan, hairy clumps on the underside of tree branches, in bark fissures, under rocks and in other protected areas.

EIS.--Acronym for environmental impact statement.

Endangered species.--Any species that is in danger of extinction throughout all or a significant part of its range. Endangered species are designated in the Federal Register by the Secretary of Interior.

Endemic.--Of or confined to a particular locality. When contrasted to "epidemic", refers to relatively low and stable populations.

Endocuticle.--Innermost layer of the external skeleton of insects, made up of chitin and protein.

Environmental analysis.--An analysis of alternative actions and their short- and long-term, direct, indirect and cumulative effects. The analysis includes physical, biological, economic, social, and environmental consequences and their interactions.

Environmental assessment (EA).--A concise public document that: briefly provides sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement or a finding of no significant impact; aids an agency's compliance with the act when no Environmental Impact Statement is necessary; and, facilitates preparation of a statement when one is necessary.

Epidemic.--An outbreak, i.e., an abnormally large, rapidly spreading pest population.

Even-aged management.--The application of a combination of actions that results in the creation of stands in which trees of essentially the same age grow together. Managed even-aged forests are characterized by a distribution of stands of varying ages (and, therefore, tree sizes) throughout the forest area. The difference in age between trees forming the main canopy level of a stand usually does not exceed 20 percent of the age of the stand at harvest rotation age. Regeneration in a particular stand is obtained during a short period at or near the time that a stand has reached the desired age or size for regeneration and is harvested. Clearcut, shelterwood, or seed tree cutting methods produce even-aged stands.

Final environmental impact statement (FEIS).--An agency's official position on its responsibilities under the National Environmental Policy Act. The statement is prepared after comments have been received and considered on a draft edition. (See "Draft environmental impact statement.")

Floodplain.--The lowland and relatively flat areas adjoining inland and coastal waters (including debris cones and floodprone areas of offshore islands) including, at a minimum, those areas subject to a 1-percent or greater chance of flooding in any given year (100-year recurrence).

Forb.--Any herbaceous plant other than grass or grasslike plants.

Forest Plan.--See National Forest Land and Resource Management Plan.

Formulation.--The form in which a pesticide is packaged or prepared for use.

FPM.--Forest Pest Management Staff Unit, USDA Forest Service.

Fuels.--A term used to describe material such as dead brush and trees that provide material for fires.

Game species.--Animals (including fish) which are protected by State or Federal regulations and pursued by sportsmen and women i.e., squirrel, rabbit, deer, bear, turkey, trout, bass, etc.

General forest area.--Land of which at least 10 percent consists of forest trees of any size. Also includes land that formerly had such tree cover, and not currently developed for nonforest use.

GIS.--Acronym for Geographic Information System. This is a computerized system used to store, analyze and plot data in map format. It is used to describe where and when conditions have existed in the past in order to aid in making decisions on future actions.

Habitat.--The place where a plant or animal lives. Habitat consists of food, water, cover and space.

Half-life.--The time required for half the amount of substance (such as an insecticide) in or introduced into a living system to be eliminated whether by excretion, metabolic decomposition, or other natural process.

High-hazard tree.--One which, because of a lack of structural integrity, poses a danger to people or property.

ICO.--Acronym for Issues, Concerns, and Opportunities.

Infestation.--The presence of large numbers of insects in an area.

Inherited sterility.--A developing technique used for managing gyspy moth populations. Laboratory-reared male gypsy moth pupae are exposed to radiation and mated with normal females. The resulting eggs are partially sterile. These eggs are collected in the laboratory and released into natural gypsy moth populations in the field. The partially sterile eggs produce sterile larvae which feed and develop normally, mate with the normal females but result in completely sterile eggs and no progeny.

In-holdings.--Lands within the boundaries of a national forest, and which are owned by another agency, organization or person.

Innocuous phase.--The first phase of a gypsy moth outbreak, characterized by very low populations of the gypsy moth. This phase may last for many years (see also: release phase, outbreak phase, decline phase).

Instar.--The term for a insect before each of the molts (shedding of its skin) it must go through in order to increase in size. Upon hatching from its egg, the insect is in instar I and is so called until it molts, when it begins instar II, etc.

Integrated pest management (IPM).--IPM is a process for selecting strategies to regulate forest pests to achieve resource management objectives. It is the planned and systematic use of detection, evaluation, and monitoring techniques; and all appropriate silvicultural, biological, chemical, genetic, and mechanical tactics needed to prevent or reduce pest-caused damage and losses to levels that are economically, environmentally, and aesthetically acceptable.

Interdisciplinary team (ID team).--Consists of persons with different professional backgrounds useful in preparing an environmental impact statement. The members of the ID Team that prepared this EIS are listed in chapter V.

Intermediate cut.--Any removal of trees from a stand between the time of their formation and the harvest.

Intervention tactics.--The range of management activities that are used against a pest. Available intervention tactics against the gypsy moth include silvicultural activities, parasites and predators, male confusant techniques, mass trapping, sterile egg release, the use of the gyspy moth-specific nucleopolyhedrosis virus (available as Gypchek[R]), and the use of biological and chemical insecticides.

Invertebrate.--The group of animals characterized by the lack of a backbone which includes arthropods and clams.

Irretrievable.--Applies to losses of production, harvest, or commitment of renewable natural resources. For example, some or all of the timber production from an area is irretrievably lost during the time an area is used as a winter sports site. If the use is changed, timber production can be resumed. The production lost is irretrievable, but the action is not irreversible.

Irreversible.--Applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.

Issue.--A subject or question of widespread public interest relating to the AIPM project.

Larva.--An immature, worm-like stage of an insect, between the egg and pupa.

LD_{50}.--Median lethal dose, is the milligram of toxicant per kilogram of body weight (mg/kg) lethal to 50 percent of the test animals to which it is administered under the conditions of the experiment.

Lepidoptera.--A large order of insects, including the butterflies and moths; characterized by four scale-covered wings and coiled sucking mouthparts.

Major issues.--The result of consolidating issues, concerns and opportunities identified in scoping. Major issues form the basis for developing and evaluating alternatives and, analyzing effects.

Management area.--An area that has a common management direction. For example, an area of general forest adjacent to a wilderness boundary may be managed to reduce the risk from gypsy moth.

Management concern.--An issue, problem, or an identifiable condition that constrains the range of available management practices.

Management direction.--A statement of multiple-use and other goals and objectives, the associated management prescriptions, and the standards and guidelines for attaining them.

Management practice.--A specific act, measure, or course of action, or treatment.

Management prescription.--Management practices and intensity selected and scheduled for application on a specific area to attain multiple-use and other goals and objectives.

mg/kg.--Milligrams per kilogram; used to designate the amount of chemical received per kilogram of body weight of test organisms. One mg/kg = 1 ppm. One mg = 0.000035 ounce, and 1 kg = 2.2 pounds.

mg/kg/day.--Milligrams per kilogram of body weight per day.

Mitigation.--Actions to avoid, minimize, reduce, eliminate or rectify the impacts of a management practice.

Molting.--The process or casting off the old exoskeleton and creating a new one as an insect grows or changes in body form.

Multiple use.--The management of all the various renewable surface resources of the National Forest System so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some lands will be used for less than all of the resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of the uses that will give the greatest dollar return or the greatest unit output.

Mutagenicity.--The capacity of a substance to cause changes in genetic material.

National Environmental Policy Act (NEPA).--Establishes a national policy to encourage productive and enjoyable harmony between man and the environment, to promote efforts that will prevent or eliminate damage to the environment and stimulate the health and welfare of man, to enrich the understanding of the ecological systems and natural resources important to the nation, and to establish a Council on Environmental Quality.

National forest land and resource management plan.--A plan developed to meet the requirements of the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended. This plan guides all natural resource management activities, and establishes management activities, standards, and guidelines for each national forest.

National Forest Management Act (NFMA).--A law passed in 1976 amending the Forest and Rangeland Renewable Resources Planning Act that requires the preparation of Regional and Forest Plans and the preparation of regulations to guide that development.

National Forest System land.--National Forests, National Grasslands, and other related lands for which the Forest Service is assigned administrative responsibility.

National Wilderness Preservation System.--All lands covered by the wilderness act and subsequent wilderness designations, irrespective of the department or agency having jurisdiction.

Natural integrity.--The degree as to which long-term ecological processes are intact and operating. The extent to which human influences have altered natural processes away from conditions one might expect had these impacts not occurred.

Natural regeneration.--The renewal of a tree crop by natural means, or without efforts to seed or plant trees. The new trees grow from selfsown seeds or by vegetative means such as root suckers.

NEPA process.--All measures necessary for compliance with the requirements of Section 2 and Title I of NEPA.

NOEL.--The No Observable Effect Level. In a series of dose levels tested, it is the highest level at which no effect is observed.

Nontarget organisms.--Any living entity that is not the target of the application of a management tactic.

Nucleopolyhedrosis virus (NPV).--A category of viruses. In the context of the gypsy moth, a virus that is specific to it. It has been formulated and registered as an insecticide, Gypchek[R].

Objective.--A concise, time-specific statement of measurable, planned results that respond to chosen goals. An objective forms the basis for further planning to define the precise steps to be taken and the resources to be used to achieve the goals.

Old growth.--Forest plant communities that exhibit a greater diversity of structure and stand condition than other sucessional stages of the same forest type. Usually characterized by older trees that show signs of decline.

Outbreak.--See epidemic.

Outbreak Phase.--The phase of a gypsy moth outbreak characterized by extremely high populations of the pest, causing widespread and serious damage (see also: decline phase, innocuous phase, release phase).

Parasite.--Any animal that lives in, on, or at the expense of another.

Particulates.--Small particles suspended in the air and generally considered pollutants.

Pheromone.--An odor given off by insects which influences the behavior of other members of the same species (and in some cases, other species also).

Pheromone trap. --Traps developed to catch male gypsy moths. There are several types, but they all are baited with an artificially manufactured female gypsy moth sex attractant called a pheromone.

Physiographic region (or subregion).--An area or division of land in which the pattern of topographic elements (altitude, relief and land forms) are characteristic throughout and as such, distinguish it from other areas with different sets of topographic elements.

Phytotoxic.--Poisonous or harmful to plants.

Ppm.--Parts per million; the number of parts of substance in question per million parts of a given material. (1 ounce of salt in 62,500 lbs of sugar). One ppm = 1 mg/kg (on a weight basis) = 1 mg/liter (water or air).

Predation.--Animals feeding upon other animals, such as the gypsy moth being fed upon by skunks.

Preferred alternative.--The alternative recommended to be adopted. The preferred alternative was identified from the range of alternatives that were evaluated in the NEPA process.

Primitive recreation.--A type of recreation available in an unmodified natural environment. The site is of a size or remoteness to offer isolation from the sights and sounds of man, and a feeling of vastness of scale. Visitors have an opportunity to be part of the natural environment and encounter a high degree of challenge and risk.

Programmatic.--In the context of this document, a term meaning that the document itself represents a broad or general approach for dealing with the gypsy moth.

Proposed action.--In terms of the National Environmental Policy Act, the project, activity or decision that a Federal agency iis recommending to implement or undertake.

Proposed species.--Any species of fish, wildlife, or plant that is proposed by the Fish and Wildlife Service or the National Marine Fisheries Service to be listed as threatened or endangered.

Pupa.--An immature, resting stage of some insects between the larva and adult.

Pupate.--A process in an insect's life cycle in which the larva develops into a pupa.

Recovery plan.--A USDI Fish and Wildlife Service approved plan which addresses recovery objectives for a plant or animal species listed as threatened or endangered.

Recreation visitor day (RVD).--Twelve visitor hours, which may be aggregated continuously, intermittently, or simultaneously by one or more persons.

Regeneration.--The renewal of a tree crop whether by natural or artificial means. Also, the young crop itself.

Release phase.--The phase of a gypsy moth outbreak following the innocuous phase during which gypsy moth populations begin to build rapidly from very low levels to populations capable of causing widespread and serious damage (see also: innocuous phase, outbreak phase, decline phase).

Research natural areas.--An area in as near a natural condition as possible that exemplifies typical or unique vegetation and associated biotic, soil, geologic, and aquatic features. The area is set aside to preserve a representative sample of an ecological community primarily for scientific and educational purposes.

Resource use and development opportunities.--A possible action, measure, or treatment introduced during the scoping process which subsequently may be incorporated into and addressed by the EIS in terms of a management prescription.

Riparian areas.--Geographically delineated areas, with distinctive resource values and characteristics, that are comprised of the aquatic and riparian ecosystems, floodplains, and wetlands.

Riparian ecosystem.--A riparian ecosystem is a transition between the aquatic ecosystem and the adjacent terrestrial ecosystem and is identified by soil characteristics and distinctive vegetation communities that require free or unbound water.

Scenic value.--A desired level of visual quality based on physical and sociological characteristics of an area.

Scope.--The range of actions, alternatives, and impacts to be considered in an environmental impact statement.

Scoping.--The procedure by which the Forest Service determines the extent of analysis necessary for an informed decision on a proposed action. Scoping is an integral part of environmental analysis.

Sensitive species.--Those plant and animal species within the Project Area identified by:

a. Regional Foresters as having significant current or predicted downward trends in population numbers or density or, significant current or predicted downward trends in habitat capability that would reduce species distributions on National Forest System lands;

b. The Virginia Commission of Game and Inland Fisheries as State endangered, threatened, proposed or candidate species;

c. The West Virginia Department of Natural Resources as State critically imperiled, imperiled, or imperiled globally or;

d. The USDI Fish and Wildlife Service as candidate species under review for listing.

Shade-intolerant plants.--Plant species that do not germinate or grow well in shade.

Shade-tolerant plants.--Plants that grow well in shade.

Silvicultural system.--A management process whereby forests are tended, harvested, and replaced, resulting in a forest of distinctive form. Systems are classified according to the method of carrying out the fellings that remove the mature crop and provide for regeneration and according to the type of forest thereby produced.

Silvicultural treatments.--Actions taken in a forest based on the theory and practice of controlling the establishment, composition, constitution, and growth of forests.

Site preparation.--The removal of competition and conditioning of the soil to enhance the survival and growth of seedlings or to enhance the germination of seed.

Slash.--Woody debris left after logging, pruning, thinning or brush cutting. It includes logs, chunks, bark, branches, stumps, and broken small trees or brush.

Snags.--Individual standing dead trees, interspersed within healthy, growing forest stands.

Soil compaction.--Any process by which the soil grains are rearranged to decrease void space and bring them into closer contact with one another, thereby increasing the weight of solid material per cubic foot.

Soil productivity.--The capacity of a soil to produce a specific crop, such as fiber, forage, under defined levels of management. It is generally dependent on available soil moisture and nutrients and length of growing season.

Solitude.--Isolated from the sights, sounds, and presence of others and the developments and evidence of humans.

Stand.--Trees that grow in the same location, and which are fairly uniform in type, age and risk classes, vigor, stand-size class, and stocking class. The similarity of these qualities distinguish the stand from adjacent stands that contain trees with different features.

Standard.--A principle requiring a specific level of attainment; a rule to measure against.

Succession.--The progressive development of trees or other plants toward their highest role in their ecology; their climax. The replacement of one forest, or other plants, by others.

Suppression.--Suppression activities must use the strategy which applies the best combination of available tactics considering effectiveness with respect to resource management goals, economics, environmental concerns and human safety. Suppression takes two forms--direct and indirect.

Direct suppression is action taken against a pest to reduce its population. Examples are prescribed fire, removal of pests by cutting and removing infested materials, use of pesticides, and release of parasites or predators.

Indirect suppression is the altering of conditions favorable to a pest population and leads to a decline. It involves the same activities as prevention. The difference between prevention and indirect suppression is that in indirect suppression, damaging

pest populations already exist and the intent is to reduce their damage to an acceptable or tolerable level.

Suppression projects.--A systematic, planned and budgeted effort to control a pest.

Supplemental wilderness attributes.--Ecological, geopogical or other features of scientific, educational, scenic, or historical value although not necessary in wilderness, do enhance wilderness quality if they exist to any extraordinary degree.

Syncline.--A downfold of stratified rocks, from whose central axis the beds rise upward and outward in opposite directions (see: anticline).

Threatened species.--Any plant or animal that is likely to become an endangered species within the foreseeable future in all, or a significant portion, of its range. Threatened species are designated in the Federal Register by the Secretary of the Interior.

Tiering.--Refers to the coverage of general matters in broader environmental impact statements (such as national program or policy statements) with subsequent narrower statements or environmental analyses (such as regional or basin-wide program statements or ultimately site-specific statements) incorporated by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared.

Timber stand improvement (TSI).--Activities conducted in young stands of timber to improve growth rate and form of the remaining trees.

24-C Registration.--A temporary (90-day) pesticide use permit issued by a State. A 24-C registration allows use of Federally-registered pesticides for additional uses, not currently on the lable, as required to meet local needs. For additional information, see section 24, subsection C of reference 38.

Two-lined chestnut borer.--*Agrilus bilineatus*. A long-horned beetle that attacks oaks that have been weakened by drought or defoliation. They cause considerable mortality in trees that have been defoliated by gypsy moth.

Type.--A classification of forest land based on the tree species that predominates in the area.

Type conversion.--The conversion of the dominant vegetation in an area from one species to another.

Understory.--Plants growing below the canopy of other plants. Usually refers to grasses, forbs, and low shrubs under a tree or brush canopy.

Uneven-aged management.--The application of a combination of actions needed to simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter and provide for the orderly growth and development of trees through a range of diameter or age classes to provide a sustained yield of forest products. Cutting is usually regulated by specifying the number or proportion of trees of particular sizes to retain within each area, thereby maintaining a planned distribution of size classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection.

USDA.--U.S. Department of Agriculture.

USDI.--U.S. Department of the Interior.

Watershed.--The entire area that contributes water to a drainage system or stream.

Wetlands.--Those areas that are inundated by surface or ground water often enough to support plants and other aquatic life that requires saturated or seasonally saturated soils for growth and reproduction. Wetlands generally include swamps, marshes, bogs and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds.

Wilderness.--Areas designated by congressional action under the 1964 Wilderness Act including subsequent supplements and amendments. Wilderness is defined as undeveloped Federal land retaining its primeval character and influence without permanent improvements or human habitation. Wilderness areas are protected and managed to preserve their natural conditions, which generally appear to have been affected primarily by the forces of nature with the imprint of human activity substantially unnoticeable; have outstanding opportunities for solitude or for a primitive and confined type of recreation; include at least 5,000 acres or are of sufficient size to make practical their preservation, enjoyment, and use in an unimpaired condition; and may contain features of scientific, educational, scenic, or historical value as well as ecologic and geologic interest.

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Abbott Laboratories. 1986. Dipell 8AF worm killer bacillus thuringiensis insecticide; Specimen label: Chemical & Agricultural Products Division, North Chicago, Illinois 60064.

Bent, A.C. 1942. Life histories of North American flycatchers, larks, swallows and their allies; Alder flycatcher, pp204-213; Dover Publications.

Bent, A.C. 1948. Life histories of North American nothatches, wrens, thrashers and their allies; Bewick's wren, pp176-183; Dover Publications.

Bent, A.C. 1950. Life histories of North American wagtails, shrikes, virgos and their allies; Loggerhead shrike, pp131-148; Dover Publications.

Blumberg, Andrea Y. 1986. Survey of aquatic, soil and soil surface invertebrate fauna in a North Carolina forest (pre and post application of Dimilin WP-25) a final report. Duphar B.Y. Crop Production Div. Dept. of Biochemistry /Doc. No. 56635/24/86. 42p.

Brown, J.H. Jr.; Halliwell, D.B. and Gould, W.P. 1979. Gypsy moth defoliation: Impact on Rhode Island forests. Journal of Forestry 77 (1):30-32.

Brown, L.R.; Kaya, H.K.; Reardon, R.C. and Fusco, R.A. 1984. The Santa Barbara gypsy moth eradication effort in California Agriculture, March-April 1984 pp4-7.

Cameron, E.A.; Loerch, C.R.; Mumma, R.O. 1985. Incidental and indirect exposure to three chemical insecticides used for control of the gypsy moth, Lymantria dispar (L). Department of Entomology, Pennsylvania State University, University Park, PA IUFRO Symposium. Zeitschrift fur Anqewandte Entomologie. 99(3) p241-248.

Campbell, R.W.; Sloan, R.J. 1977. Release of gypsy moth populations from innocuous levels. Environmental Entomology. 6(2):323-330.

Campbell, R.W. 1976. Comparative analysis of numerically stable and violently fluctuating gypsy moth populations. Environmental entomology. 5(6):1218-1224.

Campbell, Robert W. 1975. The gypsy moth and its natural enemies. U.S. Department of Agriculture, Forest Service. Agr. Info. Bulletin 381. p27.

Churcher, J. Joseph. 1987. Letter to D.P. Smith, USDA Forest Service, Atlanta, GA. with attachments from Ministry of Natural Resources, Forest Resources Branch, Pest Control Section. Ontario, Canada. 26p.

Commonwealth of Virginia, Department of Conservation and Economic Development, Division of Parks and Recreation. The 1984 Virginia Outdoors Plan. 1984. 196p.

Conservation. Title 16; chapter 23--National Wilderness Preservation System, section 1131, National Wilderness Preservation System. 16 CFR 1131.

Cooper, R.J.; Dodge, K.M.; Marinat, P.J.; Smith, P.M.; and Whitmore, R.C. 1987. Impacts of the gypsy moth on nongame bird populations. In: Proc. "Coping with the gypsy moth in the new frontier". West Virginia University, Morgantown, WV. p48-58.

Corbett, E.S., Heilman, J.M.; 1975. Effects of management practices on water quality and quantity: The Newark, New Jersey municpal watersheds. USDA For. Serv. Gen. Tech. Rep. NE-13. p47-57.

Corbett, E.S., Lynch, J.A. 1987. The gypsy moth - does it affect soil and water resources. In: Proc. "Coping with the gypsy moth in the new frontier". West Virginia University, Morgantown, WV. p39-46.

Corbett, E.S., Lynch, J.A. and Sopper, W.E. 1978. Timber harvesting practices and water quality in the Eastern United States. J. For. 76(8):484-488.

DeGraaf and Holland. 1978. Response of breeding birds to gypsy moth defoliation of an upland oak habitat, pp105-119 in Trans. N.E.

DeGraaf, R.M. 1987. Breeding birds and gypsy moth defoliation: Short term responses of species and guilds; Wildlife society Bulletin; Vol. 15, No. 2, Summer 1987. pp217-221.

Dubois, N.R.; Lewis, F.B. 1981. What is Baccillus thuringiensis. Journal of Arboriculture 7(9):233-240.

Fedde, G.E. 1962. Elm spanworm, a pest of hardwood forests in the southern Appalachians; J. for 62:102-107.

Forbush, E.H. and Fernald, C.H. 1896. The gypsy moth. Wright and Potter, Boston, Ma. 495p.

Frank, O.L. 1982. Natural and artifical regeneration. In: Proc. "Coping with the gypsy moth". Penn. State University, University Park, PA. pp51-59.

Gaddy, L.L. 1983. An inventory of the endangered and threatened plants of the Nantahala and Pisgah National Forests, North Carolina. Prepared for the U.S. Forest Service. Swamp Pink. pp43-45.

Grace, J.R. 1986. The influence of gypsy moth on the composition and nutrient content of litter fall in a Pennsylavania oak forest. For. Sci. 32(4):885-870.

Gottschalk, Kurt W. 1986. Managing Appalachian hardwood stands to minimize gypsy moth impacts. SAF Publ. 86-02. p181-207.

Gottschalk, KURT W. 1987. Prevention: The silvicultural alternative. p92-104. In Coping with the gypsy moth in the new frontier, a workshop for forest managers. West Virginia University, Morgantown, West Virginia.

Gottschalk, Kurt W. 1988. Gypsy moth and regenerating Applachian hardwood stands. Unpublished paper. p14.

Hayden, Arnold H. 1987. Impact of gypsy moth on game species; presented @ "Coping with the gypsy moth in the new frontier": A workshop for forest managers; Morgantown, WV. Aug. 4-6, 1987.

Helvey, J.O. and Tiedemann, A.R. 1978. Effects of defoliation by Douglas-fir Tussoch mort on timing and quantity of streamflow. USDA Forest Service Research Note PNW-326 p13.

Herrick, O.W.; Gansner, D.A. 1986. Rating forest stands for gypsy moth defoliation. Res. Pap. NE-583. Broomall, PA. U.S. Department of Agriculture, Forest Service, Northeast Forest Experiment Station; 4p.

Herrick, O.W. and Ganser, D.A. 1988. Changes in forest condition associated with gypsy moth on new frontiers of infestation. Northern J. of Applied For. 5(1):59-61.

Holmes, R.T. and Robinson, S.K. 1981. Tree species preference of foraging insectivorous birds in a northern hardwood forest. Oecologia 48:31-35.

Holmes, R.T., Sherry, T.W. and Sturgess, F.W. 1986. Bird community dynanics in a temperate deciduous forest: long term effects at Hubbard Brook. Ecol. Monogr. 56:201-220.

Hoover, G. 1987. BT induced illness? In Forest Pest Management News. Department of Environmental Resources, Bureau of Forestry, Division of Forest Pest Management, Middletown, PA. (5)9 3.

Jones, Alice S. 1987. Environmental monitoring Fires Creek gypsy moth eradication project levels of Dimilin in streams following aerial application. Unpublished report. Southeast. For. Sci. Lab. Research Triangle Park, N.C. p5.

Kingsbury, P., Sundaram, K.M.S., Holmes, S., Nott, R. and Kreutzweiser,D. 1987. Aquatic fate and impact studies with Dimilin. File Rep.78. Forest Pest Management Institute, Canadian Forestry Ser., Sault Ste. Marie, Ontario. p45.

Lautenschlager, R.A., Rothenbacher, H. and Podgwaite, J.D. 1979. Response of birds to aerial application of the nucleopolyhedrosis virus of the gypsy moth, Lymantria dispar. Environmental Entomology. 8(4):760-764.

Lautenschlager, R.A., Rothenbacher, H. and Podgwaite, J.D. 1978. Response of small mammals to aerial application of the nucleopolyhedrosis virus of the gypsy moth, Lymantria dispar. Environmental Entomology. 7(5): 676-684.

Lipford, Michael. 1988. Virginia Natural Heritage Program, Rare Species with Federal Status by County; unpublished docuement, from Virginia Natural Heritage Data base.

Love, L.D. 1955. The effect on stream flow of the hilling of spruce and pine by the Englemann spruce battle. Trans. Am. Geophys. Union 36(1):113-118.

MacGregor, J. T., D. H. Gould, Ann D. Mitchell, and G. P. Sterling. 1979. Mutagenicity tests of diflubenzuron in the micronucleus test in mice, the L5178Y mouse lymphoma forward mutation assay, and the Ames salmonella reverse mutation test. Mutation Research 66: 45-53.

Madrid, F.J. and Stewart, R.K. 1981. Impact of diflubenzuron spray on gypsy moth parasitoids in the field. J. Econ. Entomol. 74(1):1-2.

Martinat, P.J., Copper, R.J., Dodge, K.M., Seidle, G.E. and Whitmore, R.C. 1986. Effects of Dimilin applications on insect, bird, and small mammal populations in Sleepy Creek Public Hunting and Fishing Area, Berkly Springs, West Virginia. West Virginia Univ. Morgantown, WV. Unpublished report.

Martinat, P.J., Whitmore, R.C., Coffman, C.C., Dodge, K. and Cooper, R.J. 1988. Effect of Dimilin 25-W on the canopy arthropod community in a central Appalachian forest. Div. of For. West Virginia Univ. Morgantown, WV. Environmental Entomol. p24.

Martinat, P.J., Coffeman, C.C.; Dodge, K.; Cooper, R.J. and R.C. Whitmore. 1988. Effect of diflubenzuron on the canopy arthropod community in a central Appalachian ; rest. J. Econ. Entomol. 81(1):261-267.

Mason, C.J., McManus, M.L. 1981. Larval dispersal of the gypsy moth. Chapter 4, p.161-202. In The Gypsy Moth: Research Toward Integrated Pest Management. U.S. Department of Agriculture. Tech. Bull. 1584.

Mass, W. et al. 1980. Benzoylphenylurea insecticides. R. Wegler [ed] Chemic Der Pflanzenschutz. Und Schadlingsbekamp-Fungsmittel, Band 6 Springer-Verlag, Berlin. p423-470.

Mazzone, H.M.; Tignor, G.H.; Shope, R.E.; Pan, I.C. and Hess, W.R. 1976. A serological comparison of the nuclear polyhedrosis virus of the gypsy moth and the European pine sawfly with arthropod-borne and oather viruses. Environmental Entomology. 5(2)281-282.

McConnel, Steven P. 1988. Effects of gypsy moth defoliation on acorn production and viability, litterfall and litter layer depth and biomass in North-Central Virginia and Western Maryland. Virginia Poly. Inst. and State Univ. Unpublished thesis.

McDonald, Brian. 1988. Rare Invertebrates Documented for West Virginia and West Virginia Natural Heritage Program State Element List; Unpublished docuements from West Virginia Natural Heritage Database.

McGowan, J. 1985. Forest tent caterpillar spray project, Murphysboro Ranger District. USDA For. Ser. Shawnee Nat. For. Unpublished report. p11.

McManus, M.L. 1980. The gypsy moth. For. Insect and Diseal Leaf. 162. U.S. Department of Agriculture, Forest Service; 1980. 10p.

Morris, R.F.; Cheshire, W.F.; Miller, C.A.; and Mott, D.G. 1958. The numerous response of avian and mammalian predators during a graduation of spruce budworm. Ecology 39:487-494.

National Cancer Institute. 1979. Bioassay of p-chloroaniline for possible carcinogencity. Tech. Rep. Series No. 189. U.S. Department of Health, Education, and Welfare, Public Health Service. 89p.

National Research Council of Canada. 1976. Bacillus thuringiensis: Its effects on environmental quality. NRCC No. 15885.

Nimmo, W. B., P. C. de Wilde, and A. Verloop. 1984. The degradation of diflubenzuron and its chief metabolites in soils. Part I: Hydrolytic cleavage of diflubenzuron. Pestic. Sci. 15: 574-585.

Nixon, Charles M. and Hansen, L.P. 1987. Managing forests to maintain populations of gray and fox squirrels; Illinois Dept. of Conservation Technical Bulletim #5; Illinois Natural History Survey; p35.

Olkowski Et Al. 1980. Use of microbial insecticide Bacillus Thuringiensis in IPM. The IPM Practitioners Newsletter of Intergrated Pest Management. Berkley, CA. Vol. 2 No.4.

Patric, J.H. 1976. Soil erosion in eastern forests. J. For. 74(10):671-677.

Podgwaite, J.D.; Bruen, R.B.; Shapiro, M. 1983. Micro-organisms associated with production lots of the nucleopolyhedrosis virsus of the gypsy moth, Lymantria dispar (Lep: Lymantriidae) Entomophaga. 28(1):9-15.

Porter, Dr. Duncan M. and Croy, S.Q. 1982. Inventory of porposed threatened and endangered vascular plant species on the George Washington National Forest, Virginia; Final report; Dept. of Biology, Virginia Polytechnic Institute and State University; Shale Barren Rockcress pp11-13.

Potts, D.F. 1984. Hydrologic impact of a large-scale mountain pin beetle (Dendroctonus ponderosac Hophins) epidemic. Water Resource Bull. 20(3):373-377.

Quarles, J. M., J. O. Norman, and L. F. Kubena. 1980. Absence of transformation by diflubenzuron in a host mediated transplacental carcinogen assay. Bull. Env. Contam. and Toxicol. 25(a): 252-256.

Quimby, J.W. 1987. Impact of gypsy moth defoliation on forest stands. In: Proc. "Coping with the gypsy moth in the new frontier". West Virgina University, Morgantown, West Virginia. p21-29.

Robinson, S.K. and Holmes, R.T. 1984. Effect of plant species and foliage structure on the foraging behavior of forest birds. AUK. 101:672-684.

Shadbolt, C. A. 1985. Letter to John Neisess discussing the possible dioxin contamination of diflubenzuron. March 20, 1985.

Sharpe, W.E. 1982. Effects of gypsy moth defoliation in Pennsylvania on water quality and quantity, pp95-102 in Proceedings of coping with the gypsy moth, Feb. 17-18, 1982. The Pennsylvania State University.

Smith, H.R. 1985. Wildlife and the gypsy moth; Wildlife Society Bulletin 13:166-174.

Smith, H.R. and Campbell, R.W. 1978. Woodland mammals and the gypsy moth: American Forests. 84 (5)p22-24.

Swift, L.W.; Messer, J.B. 1971. Forest cutting raise temperatures of small streams in the southern Appalachians. Journal of Soil and Water Conservation. 26:111-116.

Taylor, R.A.J, and Reling, D. 1986. Density/height profile and long-range dispersal of first-instar gypsy moth (Lepidopterai Lymantriidae) Environmental Entomology. 15: 431-435.

Thomson, Christine. 1982. Myotis sodalis; Mammalian species No. 163, published by the American Society of Mammalogists.

Towers, Dr. Barry and Orr, Pete. 1988. Environmental assessment, 1988 cooperative gypsy moth suppression project. PA Dept. of Envir. Resc. and USDA For. Ser. Unpublished report. p66.

Tuthill, R.W.; Canada, A.T.; Wilcock, K.; Etkind, P.H.; O'Dell, T.M. and Shama, S.K. 1984. An epidemiologic study of gypsy moth rash. American Journal of Public Health. 74(8) p799-803.

U.S. Department of Agriculture. 1981. The gypsy moth: Research toward integrated pest management. Technical Bulletin 1584. 757p.

U.S. Department of Agriculture. 1985. Final environmental impact statement, land and resource management plan, Jefferson National Forest. Roanoke, VA: U.S. Department of Agriculture, Forest Service, Southern Region, Jefferson National Forest. p560.

U.S. Department of Agriculture. 1986. Final environmental impact statement, land and resource management plan, Mononngahela National Forest. Elkins, WV: U.S. Department of Agriculture, Forest Service, Eastern Region, Monongahela National Forest. p635.

U.S. Department of Agriculture. 1986. Final environmental impact statement, land and resource management plan, George Washington National Forest. Harrrisonburg, VA: U.S. Department of Agriculture, Forest Service, Southern Region, George Washington National Forest. p560.

U.S. Department of Agriculture. 1985. Jefferson National Forest land and resource management plan. Roanoke, VA: U.S. Department of Agriculture, Forest Service, Southern Region, Jefferson National Forest. p304.

U.S. Department of Agriculture. 1986. Monongahela National Forest land and resource management plan. Elkins, WV: U.S. Department of Agriculture, Forest Service, Eastern Region, Monongahela National Forest. p608.

U.S. Department of Agriculture. 1986. George Washington National Forest land and resource management plan. Harrisonburg, VA: U.S. Department of Agriculture, Forest Service, Southern Region, George Washington National Forest. p151.

U.S. Department of Agriculture, Forest Service. 1975. Endangered, threatened and unique mammels of the Southern National Forests. USDA Forest Service, Southern Region. p132.

U.S. Department of Agriculture, Forest Service. 1981. Wildlife Habitat Management Handbook, Chapter 400, Southern Bald Eagle, Section 418. USDA Forest Service. p9.

U.S. Department of Agriculture, Forest Service. 1982. Endangered and threatened species of the southeastern United States including Puerto Rico and the Virgin Islands. USDA Forest Service, Southern Region. 3 vol.

U.S.Department of Agriculture, Forest Service. 1982. Virginia Round-Leaf Birch Recovery Plan. p57.

U.S. Department of Agriculture, Forest Service. 1983. A report on some rare, threatened or endangered forest-related vascular plants of the south. Technical Publication R8-TP2; Volume II, Harparella pp820-824.

U.S. Department of Agriculture, Forest Service. Forest Service Manual, Title 2300, Recreation, Wilderness, and Related Resource Management, Chapter 2320, Wilderness Management, Section 2320.2, Amendment 97, April 1986. Washington:USDA Forest Service.

U.S. Department of Agriculture, Forest Service. 1987. Final environmental assessment for gypsy moth suppression on the Allegheny National Forest, Warren, Forest and Mckean Counties, Pennsylvania. USDA Forest Service, Region 9, Allegheny Nat. For. p116.

U. S. Department of Agriculture, Forest Service. 1987. Final environmental impact statement for the suppression of the southern pine beetle. USDA Forest Service, Southern Region. Vol. 1:Chap.I-VI, VIII-X. p384.

U. S. Department of Agriculture, Forest Service. 1988 In Prep.; Forest Service List of Sensitive Animal Species on Appalachian Mountains National Forests For, Draft EIS Vegetation Management in the Appalachian Mountains, to Press.

U.S. Department of Agriculture, Forest Service; Animal and Plant Health Inspection Service. 1985a. Final Environmental Impact Statement as Supplemented-Gypsy Moth Suppression and Eradication Projects. U.S. Government Printing Office, Washington DC. p411.

U.S. Department of Agriculture, Forest Service; Animal and Plant Health Inspection Service. 1985b. Final Addendum to the Final Environmental Impact Statement as Supplemented - Gypsy Moth Suppression and Eradication Projects. U.S. Government Printing Office, Washington, DC. p246.

U.S. Department of Interior. 1981. Shenandoah National Park environmental assement/general management plan. Denver Service Center: U.S. Department of Interior, National Park Service, Mid-Atlantic Region, Shenandoah National Park. p362.

U.S. Department of Interior. 1983. Shenandoah National Park general management plan/development concept plan. Denver Service Center: U.S. Department of Interior, National Park Service, Mid-Atlantic Region, Shenandoah National Park. p247.

U.S. Department of Interior, Fish and Wildlife Service. 1976. Recovery Plan for the Indiana Bat. p40.

U.S. Department of Interior, Fish and Wildlife Service. 1982. Gray Bat Recovery Plan. p98.

U.S. Department of Interior, Fish and Wildlife Service. 1984. Recovery Plan Ozark Big Eared Bat and Virgina Big Eared Bat. USDI Fish and Wildlife Service, Region III, Twin Cities, MN.

U.S. Department of Interior, Fish and Wildlife Service. 1984. Southern States Bald Eagle Recovery Plan. USDI Fish and Wildlife Service, Southeast Region. p143.

U.S. Department of Interior, Fish and Wildlife Service. 1987. Habitat management guidelines for the bald eagle in the southeast Region; Third revision.

U.S. Department of Interior, Fish and Wildlife Service. 1988. Interagency Communication on Endangered Species in Virginia; Glenn Kinser; Ltr. to John Alcock, Aug. 22, 1988; and Interagency Communication on Endangered Species in W. Virginia; Charles J. Kulp; Ltr. to John Alcock, Sept. 1, 1988.

U.S.Department of Interior, National Park Service. 1987. Gypsy moth integrated pest management plan. Luray:VA: U.S. Department of Interior, National Park Service, Mid-Atlantic Region, Shenandoah National Park. p90.

U.S. Environmental Protection Agency. 1979. Diflubenzuron Decision Document.

U.S. Environmental Protection Agency. 1984. Tox One Liner for diflubenzuron. Tox. Chem. No. 346A. Last updated 11/13/84. Reference is available from the U.S. Environmental Protection Agency, Freedom of Information Office. Washington, D.C. USEPA 1984.

U.S. Environmental Protection Agency. 1985a. Letter from Allan Hirsh, Director, Office of Federal Activities, to James L. Stewart, USDA Forest Service, concerning EPA's position concerning rat and mouse oncogenicity studies on diflubenzuron. March 8, 1985.

U.S. Environmental Protection Agency. 1985b. Letter from Judith Wheeler, Attorney, EPA Pesticides and Toxic Substances Division, to John Neisess, USDA Forest Service, discussing the possibility of contamination of diflubenzuron with dioxin. March 21, 1985.

Uniroyal, 1983. Dimilin-25W Technical Data sheet. March 1983. 4p.

Valentine, H. and Houston, D. 1984. Identifying mixed-oak stand susceptibility to gypsy moth defoliation; an update: For. Sci. 30:270-271.

Walstad, J.D.; Dost, F.N. 1984. The health risks of herbicides in forestry: A review of the scientific record. College of Forestry, Oregon State University, Corvallis, Oregon.

Wargo, Philip M. 1977. Armillariella mellea and Agrilus bilineatus and mortality of defoliated oak trees. Forest Science. 23(4):485-492.

Wells - Goslin, N. and Hgangy, L.R. 1984. Glaucomys Sibrinus Mammian Species 247. Am. Soc. of Mammalogists.

Whelan, C.J., Holmes, R.T., and Smith, H.R., (In Press) Bird predation on the gypsy moth (Lepidoptera: Lymantridae) larvae: an aviary study. Environ. Entom.

Willcox, H.; Coffey, T. 1978. Environmental impacts of diflubenzuron (Dimilin) insecticide. Forest Insect and Disease Management, Northeastern Area, State and Private Forestry, U.S. Department of Agriculture, Forest Service, Broomall, PA. 18p.

APPENDIX A

APPENDIX A

WILDERNESS

Congress passed the Wilderness Act "to secure for the American people of present and future generations, the benefits of an enduring resource of wilderness". Federally-owned areas were to be "administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness ...". The Act describes wilderness as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." Wilderness is further defined in the Act as "an area of undeveloped Federal land retaining its primeval character and influence ...."

The Act further defines wilderness as an area that:

1. generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;

2. has outstanding opportunities for solitude or a primitive and unconfined type of recreation;

3. has at least 5,000 acres of land or is of sufficient size as to make practical its preservation and use in an unimpaired condition, and

4. may also contain ecological, geological, or other features of scientific, educational, scenic or historical value.

The Wilderness Act directs the Forest Service and National Park Service to protect the natural character of wilderness and to provide for recreational, scenic, scientific, educational, cultural, and historical uses of wilderness.

Wilderness Management Goals

Wilderness is a unique and vital natural resource. Based on the management direction derived from the Wilderness Act (P.L. 88-577) wilderness is managed to minimize the impact of man and his technology. Management seeks to minimize the impact of use rather than use itself. In this respect, man is a temporary visitor who leaves no permanent imprint. The forces of nature dominate the landscape; man's activity is limited to that of an unobtrusive observer. Manipulation of the flora, fauna, or the surface of the land is not allowed.

Wilderness exemplifies freedom, but is characterized more by the absence of human impact than by an absence of human controls. Management is tailored to preserve spontaneity of use and as much freedom from regimentation as possible, while preserving the naturalness of the wilderness resource. To the extent that the wilderness resource is not impaired, wilderness is managed to provide opportunities for primitive recreation featuring solitude, physical and mental challenge, freedom from the intrusion of unnatural sights and sounds, the chance to experience unmodified natural ecosystems, and to travel and live without mechanized aids in an environment where successes and failures are directly dependent on one's abilities and knowledge.

In order to accomplish these goals, national forest wilderness resources are managed to promote, perpetuate and, where necessary, restore the wilderness character of the land. Management will enhance specific wilderness values of

solitude, physical and mental challenge, scientific study, inspiration and primitive recreation. To accomplish this, the Forest Service Manual, 2320.2, Amend. 97, 1986, directs the Forest Service to:

1. Maintain and perpetuate the enduring resource of wilderness as one of the multiple uses of National Forest System land.

2. Maintain wilderness in such a manner that ecosystems are unaffected by human manipulation and influences so that plants and animals develop and respond to natural forces.

3. Minimize the impact of those kinds of uses and activities generally prohibited by the Wilderness Act, but specifically expected by the Act or subsequent legislation.

4. Protect and perpetuate wilderness character and public values including, but not limited to, opportunities for scientific study, education, solitude, physical and mental challenge and stimulation, inspiration, and primitive recreation experiences.

5. Gather information and carry out research in a manner compatible with preserving the wilderness environment to increase understanding of wilderness ecology, wilderness uses, management opportunities, and visitor behavior.

Descriptions of the 15 Specific Wildernesses

Wilderness locations are found in the Alleghany Plateau, Appalachian Ridge and Valley, and Blue Ridge geographic provinces. The areas all have tree species that make excellent gypsy moth hosts. Following is a brief description of the general characteristics and attributes of the areas.

Ramseys Draft Wilderness

General Description

This 6,725 acre-area is in the Deerfield Ranger District of the George Washington National Forest in Augusta and Highland Counties, Virginia. It is approximately 18 miles northwest of Staunton, Virginia. Elevations range from 2,200 to 4,282 feet on top of Hardscrabble Knob. The terrain is mountainous with narrow ridgetops and steep slopes. The forest consists of chestnut, scarlet, red, white and black oaks as well as various other hardwood species on the slopes to hemlock, white pine and cove hardwoods in the drainage bottoms. Virgin stands of hemlock are located in the upper drainages of the area.

Natural Integrity

The area is affected by natural forces as a self enclosed drainage with the only outside influence being acid rain. This is currently being studied and has yet to cause noticeable change in the ecosystem of the drainage.

Apparent Naturalness

The area within the wilderness has been considered a special area even before wilderness designation. Commercial logging has never occurred with the only timber cut being the salvage of dead and dying trees in proximity to an old road

down the center of the drainage. This road has been destroyed by recent flooding. Evidence of the road remains but does not impair the wilderness quality.

Outstanding Opportunities for Solitude

The steep slopes of the rugged terrain, dense vegetation and few access points allow opportunities for solitude. Areas along existing trails offer less solitude while cross country travel offers the best opportunity. Sounds from U.S. Highway 250 penetrates the wilderness area for a short distance at its most southern access point.

Opportunities for Primitive Recreation

The opportunities for primitive recreation are abundant in the area. There are few hazards that encourage challenging experiences. Current recreational use consists of hiking, backpacking, camping, hunting and nature study. Visitors primarily engage in day use activities, mainly hunting and hiking. Highest recorded use occurred in October and November during the hunting season. Recreational use is considered light for the entire area with use concentrated on the old road location and existing trail.

Supplemental Wilderness Attributes

The virgin hemlock stands located in the upper drainages of the area are unique and significant features in the wilderness as well as on the national forest. These stands are typical of those found in more northern latitudes. The Ramseys Draft Research Natural Area consisting of 1,794 acres is also included within the wilderness area.

Scenic Values

The area is typical of the Appalachian Ridge and Valley land type. The steep topography, old growth vegetation and natural appearing landscapes are the greatest scenic value of the area.

St. Marys Wilderness

General Description

St. Marys Wilderness with 10,090 acres is located on the Pedlar Ranger District of the George Washington National Forest in Augusta County, Virginia. Located 10 miles south of Staunton, Virginia, St. Marys is adjacent to the Blue Ridge Parkway and comprises the upper watershed of the St. Marys River.

The river is recognized for its superb trout fishery and has been designated a Scenic River by the State of Virginia. Characterized by mixed hardwoods broken by occasional fallen rock slopes, the area ranges in elevation from 1,700 feet at the river to 3,640 feet on Cellar Mountain. Terrain is steep and rugged with many quartzite cliffs and talus slopes.

Natural Integrity

The area is a self enclosed drainage of the St. Marys headwaters which include Hogback Creek, Chimney Branch and Mine Bank Creek. Boundaries of the area are

steep and rugged affording excellent natural integrity. Of concern is the effect of acid rain on St. Marys River as it seems to be particularly susceptible to it.

Apparent Naturalness

Strip mining at the turn of the century for manganese and iron ore has impacted the area. Remnants of the excavations, railroad bed, haul roads and ore processing structures are quite evident around the area of the old mines. The rest of the area is predominately second growth hardwood forest which has acquired a natural appearance.

Outstanding Opportunities for Solitude

Along the lower portions of the St. Marys River going through the gorge is a particularly popular area readily accessible for its water related recreation. The area is considered over used in some respects and does not offer the opportunity for solitude appropriate to wilderness.

Away from the river a series of five separate free-standing mountain peaks within the area make for a great diversity of terrain and give the impression of spaciousness and solitude.

Opportunities for Primitive Recreation

St. Marys River and its gorge are particularly known for its beauty and native trout fishery. Within the steep slopes of the watershed, the terrain itself is relatively gentle. Opportunities for family-oriented primitive recreation activities exist but not of a challenging nature.

Supplemental Wilderness Attributes

St. Marys river and its gorge are the major attractions of the area.

Scenic Values

The land has a great diversity of terrain and vegetation which when viewed from overlooks of the Blue Ridge Parkway offer an unbroken forest canopy of spectacular scenery. St. Marys River and its gorge are of particular importance as a scenic resource.

Rich Hole Wilderness

General Description

Rich Hole Wilderness is approximately 12 miles northwest of Lexington, Virginia, in Alleghany and Rockbridge Counties of the George Washington National Forest. Originally comprised of 5,600 acres of the upper watersheds of North Branch, Alum Creeks and Brushy Mountain, subsequent land acquisition has increased the size to 6,450 acres since the RARE II Study.

Brushy Mountain is double crested in its central portion with the crests being separated by "holes" up to 500 feet deep which drain along cascades through gorges down to the main creeks. Giant hemlocks are found in abundance along the cascades and creeks while chestnut and scarlet oaks as well as various other hardwoods are found through the remainder of the area.

Natural Integrity

Being the upper drainage of several waterways the Rich Hole Area is minimally affected by outside forces.

Apparent Naturalness

Logging which occurred in the area approximately 100 years ago left numerous cove locations that went uncut due to their inaccessibility. These pockets of large hardwoods were focal points for Forest Service management for many years.

In 1978, the "Easter Ice Storm" severely damaged many of the large specimens through crown breakage and uprooting.

Site specific remnants from turn of the century iron mines, equipment foundations and railroad beds on the east side of the area can be found. However, these have essentially been reclaimed by natural forces.

Outstanding Opportunities for Solitude

The numerous coves and drainages provide ample opportunity for extended periods of solitude while cross country hiking. However, the trail along the east side of the area is heavily impacted by the Interstate Highway particularly near Brattons Run and Simpsons Creek Drainage.

Opportunities for Primitive Recreation

Primary uses of the area are hunting and hiking, with a popular hiking trail providing access through the area. Challenging experiences are limited to cross country hiking which is afforded by the numerous rock outcrops in the upper elevations.

Supplemental Wilderness Attributes

The term "Rich Hole" is derived from the unique areas of giant old growth trees in the rich pockets of the area. These pockets of giant trees are the key features of this wilderness area.

Scenic Values

Variety of vegetation and topography with water cascades and huge old trees contribute to the scenic quality of the area.

Rough Mountain Wilderness

General Description

On the Warm Springs Ranger District of the George Washington National Forest, Rough Mountain Wilderness is located approximately 16 miles northwest of Lexington, Virginia, in Bath and Alleghany Counties. The area comprises approximately 9,300 acres of mountain between Pads Creek on the east and the Cowpasture River on the west. The area is Characterized by rugged terrain and conspicuous rock escarpments. Upland oaks, pitch and Table Mountain Pine are the predominate forest types.

Natural Integrity

The area is a mountain ridge of consolidated Forest Service ownership and is minimally affected by outside forces.

Apparent Naturalness

The area has very few permanent improvements. Two trails are located within the area, one traverses the mountain in a northwest-southeast sidehill direction with the other trail on the ridge itself.

Outstanding Opportunities for Solitude

Bordering railroad tracks and high speed roadway are adequately buffered by dense vegetation allowing opportunities for solitude. Trails for cross country hiking provide ample opportunity for extended periods of solitude.

Primitive Recreation

Hunting and hiking are the primary uses of the area. Numerous jump-off points from bordering roads, trails, and railroad tracks facilitate access to the area. Challenging experiences from rugged terrain and rock escarpments will be limited to cross country hikers and hunters.

Supplemental Wilderness Attributes

The rugged, isolated mountain forms are the major attractions of the area.

Scenic Values

Steep, rugged terrain with little variety of vegetation. Panoramic vistas of surrounding forest land may be seen at a distance.

Cranberry Wilderness

General Description

Cranberry Wilderness with 35,864 acres is the largest single National Forest Wilderness in the state of West Virginia. It is located on the Gauley Ranger District of the Monongahela National Forest in Webster and Pocahontas Counties, West Virginia. Located approximately 70 miles northeast of Charleston, the area is characterized by broad, massive mountains with narrow steep drainages of the Cranberry and Williams Rivers. Northern and mixed hardwoods are the predominant forest cover types of the area.

Natural Integrity

The area is minimally affected by outside forces with ten percent of the area being affected.

Apparent Naturalness

Evidence of old timber cuts, railroad grades, trail shelters and a old bridge are visible but do not impair the wilderness quality. The general impression of the area is one of rugged, relatively undisturbed woodlands.

Outstanding Opportunities for Solitude

The steep drainages and vegetation screen out noise from roads or other external forces. Solitude is available to those activities that use the natural environment. Cross country hiking provides ample opportunity for extended periods of solitude.

Opportunities for Primitive Recreation

The opportunity for primitive recreation is low. There are only a few hazards that encourage challenging experiences. Current recreation use consists of hiking, backpacking, and other dispersed recreation activities. In 1986 recreation use was estimated at 34,000 visitor days.

Supplemental Wilderness Attributes

There are no unique supplemental wilderness attributes.

Scenic Values

The steep topography and natural appearing landscape are the greatest scenic values of the area.

Otter Creek Wilderness

General Description

This 20,000 acre area is in the Cheat Ranger District of the Monongahela National Forest. The area is located in Randolph and Tucker Counties, West Virginia about five miles from Elkins. Broad, massive mountains dissected by Otter Creek and its tributaries characterize the area. Northern and mixed hardwoods, red and norway spruce and upland brush are the major vegetative cover types.

Natural Integrity

Natural processes are operating in the area with approximately 10 percent of the area impacted by artificial forces.

Apparent Naturalness

Evidence of man's activities are found in old railroad grades, timber cuts, and a trail shelter. They have little impact and the apparent naturalness of the area is high.

Outstanding Opportunities for Solitude

The terrain and plant screening offer opportunities for solitude. Evidence of the old railroad grade, timber cuts and trail shelter are slowly being reclaimed by natural processes.

Opportunities for Primitive Recreation

With 13,200 visitor days of recreational use recorded in 1986, the opportunities for primitive types of recreation are low. Hiking, hunting, camping, backpacking, and other dispersed forms of recreation are the primary uses of the area.

Supplemental Wilderness Attributes

A small stand of virgin spruce and hemlock is found on the eastern boundary of the area.

Scenic Values

The area is typical Alleghaney Plateau and does not vary significantly in scenic value when compared to the rest of the National Forest.

Dolly Sods Wilderness

General Description

The Dolly Sods Wilderness is comprised of 10,215 acres of National Forest land. The area contains a portion of the headwaters of the Red Creek drainage in Tucker and Randolph Counties, West Virginia. It is approximately twelve miles west of Petersburg, West Virginia. Broad, massive mountains with steep slopes covered with red pine, red spruce, northern and mixed hardwoods as well as upland brush are characteristic of the area.

Natural Integrity

The influence of past fires, timber harvests and the establishment of pine plantations have had a moderate influence on the natural processes. Duration of these impacts will last for a number of years.

Apparent Naturalness

Man's past activities are readily apparent in the form of old timber cuts, pine plantations, railroad grades and the effects of fire. These impacts will be readily evident for a number of years to come. Overall, these impacts have only a minimal effect to the entire area and the apparent naturalness is moderate.

Outstanding Opportunities for Solitude

Wilderness solitude can be obtained to some degree by vegetative screening and terrain characteristics of the area.

Opportunities for Primitive Recreation

Opportunities for a primitive type recreation experience can be obtained to some degree but overall opportunity is low. There were 17,000 visitor use days recorded in 1986 in day use activities such as hunting and hiking. There are few hazards that encourage challenging experiences.

Supplemental Wilderness Attributes

There are no unique supplemental wilderness attributes.

Scenic Values

The scenic values are average as compared to the rest of the National Forest.

Laurel Fork North and South Wilderness

General Description

Laurel Fork Wilderness is located in Randolph County, West Virginia on the Greenbrier Ranger District of the Monongahela National Forest. It is approximately fifteen miles southeast of Elkins, West Virginia. The area is characterized by rolling mountains steeply dissected by Laurel Fork. The Laurel Fork River divides the area into two wilderness sections, Laurel Fork North (6,055 acres) and Laurel Fork South (5,997 acres). Northern hardwoods is the primary vegetative composition type of the area.

Natural Integrity

Natural processes are at work in the area. Only ten percent of the area is being impacted by artificial forces.

Apparent Naturalness

Evidence of man's activities are found in old railroad grades, timber cuts and wildlife openings. These are essentially being reclaimed by natural forces.

Outstanding Opportunities for Solitude

Topographic and plant screening provide a moderate potential for solitude. Distances from core to perimeter is short in each area.

Opportunities for Primitive Recreation

Current recreation use consists of hunting, hiking, camping, backpacking, and other dispersed recreation activities. Visitors engage primarily in day use activities. The area lacks diverse challenging opportunities.

Supplemental Wilderness Attributes

The major unique feature of the area is Laurel Fork.

Scenic Values

No outstanding scenic values are noted when compared to the rest of the National Forest.

James River Face Wilderness

General Description

This area is on the Glenwood Ranger District, Jefferson National Forest in Bedford and Rockbridge Counties, Virginia. At 8,903 acres this wilderness is approximately 8 miles from Bunea Vista and 15 miles from both Lexington and Lynchburg, Virginia. Elevations range from 600 feet at the James River to 3,037 feet at Highcock Knob. The physiographic landform is characterized by steep, sloping ridges, rocky soils and numerous cliffs and bluffs. The forest overstory is a mixed eastern hardwood forest, chestnut oak, scarlet oak and Virginia Pine at the higher, dry sites and white pine, hemlock, poplar, hickory and various other

mixed hardwoods on the moist, lower slopes and drains. Approximately 40 percent of the area is in pine and the remainder in hardwood, predominately oak.

The James River forms the northeast boundary of the wilderness area and the Blue Ridge Parkway is part of the southern boundary.

The Appalachian Trail, a national scenic trail traverses through the wilderness area.

Natural Integrity

There are two large abandoned sandstone quarries within the area. Elk Creek Quarry is adjacent to Forest Service Road 35 for approximately half a mile and is twenty acres in size. Quarrying stopped in the 1950's. Big Hellgate Quarry is located on Big Hellgate Creek, just inside the wilderness boundary. It was under special use permit until 1965 but has not been used since then. Both quarries have significantly impacted their immediate surroundings. Other impacts such as trails, shelters and roads have had a minor effect on the natural integrity.

Apparent Naturalness

The two old quarries have large areas of exposed soil and little vegetation. However, little soil movement has occurred off site but it is also apparent that little revegetation is occurring in the area.

Two Appalachian Trail shelters were in existence before wilderness designation. One shelter has been removed, Matts Creek Shelter, is still being used. Forest Service Road 602 was revegetated in the 1970's and is now the Sulphur Springs Trail and generally appears natural.

Outside of the trails and quarries, most of the interior appears natural to the visitor as there was no past timber sales or home sites.

Outstanding Opportunities for Solitude

Most of the interior of the area is remote and rugged, providing opportunities for solitude. However, there are many areas from which visitors can look down upon the developed valley below or hear traffic from Virginia Highway 130. Opportunities for solitude is also remote on the Appalachian Trail as this is a popular hiking trail.

Opportunities for Primitive Recreation

Present use of the wilderness is 3,811 recreation visitor days primarily in the form of hiking, backpacking, hunting, horseback riding and rock climbing. Six trails in addition to the Appalachian Trail provide access to the area for recreational opportunities. A large rock slide, commonly called Devils Marble Yard, just off the Belfast Trail is a frequent destination for day hikers.

Supplemental Wilderness Attributes

The rise in elevation from 650 feet near Snowden to 3,073 feet on Highcock Knob results in altitudinal differences in canopy species and associated wildlife. Within the area, several rare species of flora can be expected: *Panax quinquefolium*, Ginseng is present as well as *Tsuga carolinana*, Carolina Hemlock

which occurs as an isolated specimen. Also encountered is Castanea dentata, American Chestnut, which occurs as sprouts or saplings.

James River Face Wilderness is also the only National Forest Wilderness in the State of Virginia which has been designated as a Class I air value area.

Scenic Values

Panoramic views of the developed valley can be obtained from many areas within the wilderness. The unique views of the James River because of the topographical rise in the area enhance scenic quality.

Thunder Ridge Wilderness

General Description

At 2,450 acres, this is one of the smallest, continuous wildernesses in the AIPM Project Area. Located in portions of Rockbridge and Botetourt Counties, Virginia, the area is on the Glenwood Ranger District of the Jefferson National Forest. Glasgow, a small rural community is approximately 4 miles away while Bunea Vista (11 miles), Lexington (14 miles) and Lynchburg (15 miles) are nearby towns.

Landforms are characterized by steeply sloping ridges and rocky soils. Elevations vary from 1,300 feet near East Fork Elk Creek to 4,200 feet at Apple Orchard Mountain. Vegetation can be characterized as a mixed eastern hardwood forest containing many tree species including oaks, poplar, hickory, black cherry and hemlock. A stunted northern red oak forest dominates the summit of Apple Orchard Mountain. Approximately 85 percent of the wilderness area can be classified as upland oak.

The Blue Ridge Parkway forms the southeastern boundary of the area.

Natural Integrity

With the exception of the Appalachian Trail, there is little evidence of man's activity.

Apparent Naturalness

The overall influence of man on the naturalness is considered low. The Appalachian Trail traverses through the area and its use is well established.

Outstanding Opportunities for Solitude

The area offers limited opportunities for solitude based on its small acreage, narrow topography and southeast boundary with the Blue Ridge Parkway.

Opportunities for Primitive Recreation

Primitive opportunities for the area are minimal with backpacking and hiking the primary two uses. Challenging opportunities are limited due to the areas small size and lack of topographic features. Present use is approximately 1200 recreation visitor days.

Supplemental Wilderness Attributes

The Peaks of Otter (also known as Thunder Ridge) Salamander, Plethodon nettingi hubrichti, an threatened animal species is found within the area. Gray's lily, Lilium grayi, a threatened plant species was found on the slopes of Thunder Ridge several years ago. Its presence in the same area today has not been documented.

Ginseng, Panax quinquefolium, also occurs here and is designated as a threatened species by the State of Virginia. Near Thunder Ridge Overlook is the northeastern distribution of Carolina Hemlock, Tsuga caroliniana except for a stray specimen near the James River.

Scenic Values

The spring flora is the greatest scenic attraction in this area. Large areas dominated by the shrub Rhododendron catawbiense produces spectacular blooms while colonies of the Large Flowered Trillium, Trillium grandiflorum enrich the surroundings with color.

Shawvers Run Wilderness

General Description

This 3,665 acre area is on the New Castle Ranger District, Jefferson National Forest, in Craig County Virginia. Three population centers, ranging in population from 8,000 at Covington to 300,000 in the Roanoke complex, are within a two hour drive of this area. At 14 miles, Covington is the nearest population center while Roanoke and Clifton Forge are approximately 20 miles away.

The area contains rugged and remote mountainous tracts, covered with hardwood forests interspersed with yellow pine on the south and west exposures. Hemlock and white pine occur in the major stream bottoms. Approximately 80 percent of the area is in upland oaks and the remaining 20 percent in pine types. Elevations range from 2,000 feet along Shawvers Run to 3,800 feet atop of Hanging Rock. Valley Branch and Shawvers Run, two drainages in the area have both been classified as wild trout streams.

Natural Integrity

Timber regeneration and road construction have changed the vegetative composition to a minor degree. Man's effect on natural processes are low, generally less than 5 percent of the area.

Apparent Naturalness

The area contains 73 acres of clearcuts which occurred in 1973 and .2 mile of road which was closed in 1975. These past disturbances are being reclaimed by natural processes.

Outstanding Opportunities for Solitude

The topographic features of the Shawvers Run Drainage and the headwaters of Valley Branch will screen out much of the surrounding intrusions. Current access to the area is by cross country travel from perimeter roads.

Opportunities for Primitive Recreation

Primary uses of the area are rock climbing, fishing, hunting and backpacking. Use is considered low at 400 recreation visitor days a year.

Supplemental Wilderness Attributes

The area has a special geologic interest in the 240-acre area, Hanging Rock, which is located in the southern corner of the wilderness.

Scenic Values

The area is typical Appalachian "Ridge and Valley".

Barbours Creek Wilderness

General Description

This area is on the New Castle Ranger District of the Jefferson National Forest. It covers about 5,700 acres in Craig County, Virginia and is located approximately 20 miles from Roanoke, Virginia. The Barbours Creek Area is typical of the Appalachian Mountains in that it contains steep, rugged mountainous terrain covered with hardwood forests. Yellow pine dot the southern and western exposures while white pine and hemlock are present along major stream bottoms. Approximately 85 percent of the area is in upland oak and the remainder in pine. Elevations range from 1,700 feet along Barbours Creek to 3,800 feet along Potts Mountain.

The main stream in Barbours Creek is Lipes Branch which is classified as a wild trout stream. Streams in the area drain into the North Fork of Barbours Creek or Barbours Creek, both of which are wild trout fisheries.

Natural Integrity

Man has noticeably impacted the natural processes in the area through 260 acres of clearcut (from the time period of 1969-1975), 10 wildlife clearings and 3.4 miles of road.

Apparent Naturalness

The appearance of man's activities in the area is quite evident. Although the road and wildlife openings have been abandoned, it will take a period of time as the natural processes reclaim these areas and give them, along with the clearcuts, a naturalized appearance.

Outstanding Opportunities for Solitude

Minimal opportunities for solitude exist in this area. The north boundary along the east crest of Potts Mountain offers the best opportunity. Although this boundary is in fact a jeep road, motorized use is infrequent except during the hunting season.

Opportunities for Primitive Recreation

Opportunities exist for fishing, hiking, backpacking, camping, and hunting. Lipes Branch Trail bisects the wilderness area and is currently the only designated

trail. Present use is 1,100 recreation visitor days a year. The area along Barbours Creek and Virginia Highway 617 (adjacent to the wilderness study area) receives heavy use from campers, hunters and fishermen.

Supplemental Wilderness Attributes

The designated wild trout streams are the unique features in this area.

Scenic Values

Scenic values are typical to that of the surrounding national forest land.

Mountain Lake Wilderness

General Description

Mountain Lake Wilderness is located on the Blacksburg Ranger District of the Jefferson National Forest in Craig and Giles Counties, Virginia and Monroe County, West Virginia. The entire wilderness is 10,753 acres in size but only 4,025 acres are within the project area (that portion located in Craig County, Virginia and Monroe County, West Virginia). The nearest population center is Blacksburg, Virginia which is approximately ten air miles away. The area exhibits typical physiographic features of the Appalachian Ridge and Valley Province in that it is mountainous terrain consisting of steep slopes with high sandstone escarpments evident. Elevation ranges from 2,200 feet to 4,100 feet. Overstory vegetation in the project area is uniform in age and consists mainly of hardwoods. Dominant tree species include scarlet oak, chestnut oak, northern red oak, white oak, hickory, yellow poplar and red maple. Scattered stands of pitch and table mountain pine are also found throughout the area. The area within the project boundary is located on the slope of Potts Mountain and Little Mountain. Soils are generally stable with a low to average site index for upland oak. Crosier Branch, White Rocks Branch and South Fork of Potts Creek all support native trout populations.

Natural Integrity

Natural processes in the area have been impacted through human action in the form of a 48 acre harvest cut (which occurred in 1975), 4.2 miles of old logging roads and .9 mile of road and power line currently still being used to service two private inholdings of land (respectively 3 and 28 acres in size).

Apparent Naturalness

Past activities of human presence is evident in the form of logging roads and timber cuts which are readily apparent. Natural processes are at work in reclaiming these areas but it will take a period of time for these impacts to gain a natural appearance.

A jeep trail exists along the southern boundary and provides access to private inholdings and to a power line which also accesses the private land. As long as these facilities are being used, there will be a contrast in the natural surroundings which will be readily evident to wilderness users.

Outstanding Opportunities for Solitude

Opportunities for solitude can be obtained to a moderate degree by topographic features and vegetative screening in the area. In the northern part of this wilderness around Potts Creek Drainage, solitude is moderately compromised by the sound of vehicular traffic and the readily available access to the area by old logging roads.

Opportunities For Primitive Recreation

Current use in wilderness consists of hiking, camping, backpacking, hunting, fishing, horseback riding and rock climbing.

Supplemental Wilderness Attributes

Two animal species can be considered unique in this wilderness. The James River Spiny Mussel [*Pleurobema* (*Canthyria*) *collina*] is found in Potts Creek and Johns Creek and is on the Federal Endangered list. The Green Salamander (*Aneides aeneus*) is a sensitive species. Mountain Lake Wilderness is typical of the habitat normally occupied by this salamander.

Shenandoah National Park - Wilderness and Natural Zone

General Environment

One wilderness which consists of eight separate parcels of land and a Natural Zone are located within the AIPM project boundary on the Shenandoah National Park. These areas total approximately 267,995 acres of park land in Albemarble, Augusta, Greene, Madison, Page, Rappahannock and Rockingham Counties, Virginia. These areas are characterized by mountainous terrain covered with second growth deciduous forest. Various age classes are found throughout the areas and species composition is mixed, although the majority of the area can be classified as upland oak. Elevations range from 1,500 feet along the edge of the park boundary to approximately 4,000 feet at the summit of the Blue Ridge Mountains.

Natural Integrity

Most of the areas were utilized by man prior to the establishment of the National Park in 1936. However, nearly all the signs of man's presence have vanished from the areas and most natural processes are now functioning relatively unimpaired by human influence.

Apparent Naturalness

The areas are second growth eastern deciduous forest that appear natural. Trails, old home sites, memorials, plaques, fire rings, etc. were present before wilderness designation and can be considered as part of the natural environment.

Outstanding Opportunities for Solitude

Even though these areas are relatively small in size, they provide a high degree of solitude. This is primarily a result of the density of vegetation which screens the user from sights and sounds of adjacent land use and the topographic features of the mountainous terrain which provide secluded coves.

Opportunities for Primitive Recreation

Primary recreational uses of the areas are camping, hiking, backpacking and fishing. At the height of the Park's backcountry visitation in 1978, these areas had the highest density of use of all National Park Service areas. Although visits have tapered off in recent years, these areas are still extremely popular.

Supplemental Wilderness Attributes

Some of the best examples of specific geologic features in North America can be found in these areas.

Scenic Values

Significant scenic values can be found in the waterfalls and cascades which occur along the numerous streams in the area. Rock cliffs, rugged mountains peaks and an abundance of wildflowers and wildlife contribute to the scenic diversity of these areas.

Scenic Values

The wilderness is typical of the surrounding forest environment and does not deviate from the natural characteristic landscape.

APPENDIX B

APPENDIX B

APPENDIX B

ENDANGERED AND THREATENED SPECIES BIOLOGICAL EVALUATION

All AIPM planned, funded, executed or permitted programs or activities will be reviewed for possible effects on endangered, threatened, proposed or sensitive species. This review (biological evaluation) shall consider all available information on distribution, habitat requirements, biology and all other pertinent facts in determining effects of AIPM programs or activities on these species.

This appendix displays information used in developing a list of endangered, threatened or proposed species for the AIPM program area, identification of potential adverse effects on these species and identification of where opportunities exist to take steps to remove the potential for adverse effects. These steps are the basis for developing mitigating measures for endangered, threatened or proposed species for the AIPM project area (see chapter II, Mitigating Measures).

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Suite 322
315 South Allen Street
State College, Pennsylvania 16801

September 1, 1988

Mr. John E. Alcock
Regional Forester
U.S. Forest Service
1720 Peachtree Road, NW
Atlanta, Georgia 30367

Dear Mr. Alcock:

We have reviewed your request of August 4, 1988, regarding federally designated endangered, threatened, or proposed species found in the West Virginia portions of the Monongahela and George Washington National Forests. The Service offers the following comments.

The correct scientific name for the gray bat should read Myotis grisescens. There is some question whether this species exists in the project area. As yet the Cheat Mountain salamander has not been officially proposed for listing. The Cheat Mountain salamander is presently considered Category 1. In the plant category, add harparella, Ptilimnium nodosum, as a proposed species. The remainder of your list is correct in regard to the West Virginia portion of the project area.

In addition to the federally listed endangered, threatened, or proposed species, the Service encourages federal agencies to take the following fish, wildlife, and plant taxa into account in the planning process. Although these taxa do not receive substantive or procedural protection pursuant to the Endangered Species Act of 1973, they are under consideration for possible listing.

Category 1 comprises taxa for which the Service currently has substantial information on hand to support the biological appropriateness of proposing to list as endangered or threatened (i.e., Cheat Mountain salamander). Proposals have not yet been issued because they have been precluded at present by other listing activities.

Category 2 comprises taxa for which information now in possession of the Service indicates that proposing to list may be appropriate, but for which conclusive data on biological vulnerability and threat are not currently available to support proposed rules.

The following is a list of taxa being considered in the West Virginia portion of your project area. Many of these also occur in similar habitats in Virginia:

VERTEBRATES

Scientific Name	Common Name
Category 1	
Plethodon nettingi	Cheat Mountain salamander
Category 2	
Phenacobius teretulus	Kanawha minnow
Rhinichthys bowersi	Cheat minnow
Etheostoma osburni	Finescale saddled darter
Percina macrocephala	Longhead darter
Cottus sp.	Bluestone sculpin
Cryptobranchus alleganiensis	Hellbender
Aneides aeneus	Green salamander
Gyrinophilus subterraneus	West Virginia spring salamander
Plethodon punctatus	White-spotted salamander
Crotalus horridus horridus	Timber rattlesnake
Thryomanes bewickii altus	Appalachian Bewick's wren
Lanius ludovicianus migrans	Migrant loggerhead shrike
Aimophila aestivalis	Bachman's sparrow
Sorex palustris punctulatus	Southern water shrew
Sorex dispar	Long-tailed shrew
Microsorex hoyi thompsoni	Northeastern pygmy shrew
Condylura cristata parva	Star-nosed mole
Myotis subulatus leibii	Eastern small-footed bat
Plecotus rafinesquii	Southeastern big-eared bat
Sylvilagus transitionalis	New England cottontail rabbit
Neotoma floridana magister	Eastern woodrat
Microtus chrotorrhinus carolinensis	Southern rock vole

PLANTS

Scientific Name	Common Name
Category 1	
Arabis serotina	Shale barren rock cress
Category 2	
Allium oxyphilum	Shale barren onion
Carex polymorpha	Variable sedge
Euphorbia purpurea	Darlington's spurge
Ilex collina	Long stalked holly
Marshallia grandiflora	Barbara's buttons
Paxistima canbyi	Canby's Mountain lover
Polemonium vanbruntiae	Jacob's ladder

Saxifraga caroliniana	Gray's saxifrage
Scutellaria ovata spp. pseudoarguta	Hearted-leaved skullcap
Taenidia montana	Mountain pimpernel
Thalictrum steeleanum	Steele's meadow rue
Trifolium virginicum	Kate's Mountain clover
Trillium pusillum var. monticulum	Dwarf trillium

Sincerely,

Charles Kulp

Charles J. Kulp
Supervisor

United States Department of the Interior

FISH AND WILDLIFE SERVICE
DIVISION OF ECOLOGICAL SERVICES
1825 VIRGINIA STREET
ANNAPOLIS, MARYLAND 21401

August 22, 1988

Mr. John E. Alcock
Regional Forester
Forest Service Regional Office
1720 Peachtree Road, NW
Atlanta, GA 30367

Dear Mr. Alcock:

This responds to your August 4, 1988, request for information on the presence of species which are Federally listed or proposed for listing as endangered or threatened within the Appalachian Integrated Pest Management Gypsy Moth Project Area in Virginia and West Virginia. We understand that pesticides to be used in this project are: Gypchek, Luretape, Bt, and Dimilin. We have reviewed the information you enclosed and are providing comments in accordance with Section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*). The following listed and proposed species may be present in the concerned area:

Birds		
Falcon, American peregrine	*Falco peregrinus anatum*	E
Eagle, bald	*Haliaeetus leucocephalus*	E
Mammals		
Squirrel, Virginia n. flying	*Glaucomys sabrinus fuscus*	E
Bat, Virginia big-eared	*Plecotus townsendii virginianus*	E
Bat, Indiana	*Myotis sodalis*	E
Amphibians		
Salamander, Cheat Mountain	*Plethodon nettingi*	PT*
Salamander, Shenandoah	*Plethodon shenandoah*	PE*
Invertebrates		
Isopod, Madison Cave	*Antrolana lira*	T
Mussel, James spiny	*Pleurobema (Canthyria) collina*	E
Mussel, tuberculed blossom pearly	*Epioblasma t. torulosa*	E

Fish

Logperch, Roanoke	Percina rex	PE*

Plants

Clover, running buffalo	Trifolium stoloniferum	E
Pink, swamp	Helonias bullata	PT
Rockcress, smooth	Arabis serotina	PE*

* The proposals for these species have not yet been published in the Federal Register but they are to be proposed in the near future.

Some information on the distribution of these species is provided in the enclosed handouts.

Impacts of this project appear most likely to result from direct effects of Dimilin on the invertebrates and indirect effects on bats and the Roanoke logperch resulting from loss of their prey organisms (insects). The most vulnerable of the invertebrates appears to be the Madison Cave isopod. We recommend that spraying of Dimilin be avoided in the area recharging the groundwater aquifer which it inhabits.

The Virginia big-eared bat is probably the most vulnerable of the endangered vertebrates in the project area. Because the majority of all Virginia big-eared bat maternity colonies are within the study area and because lepidoptera are the predominant groups preyed upon by this species, evaluation of potential effects on this bat is particularly important. Results of studies currently underway to define the prey species and feeding habitats of the Virginia big-eared bat should assist the Forest Service in evaluating effects of gypsy moth spraying on this endangered species.

Rare crustaceans and insects may be particularly vulnerable to the spraying of Dimilin. Candidate species (those placed under review in the Federal Register to determine suitability for listing) in these groups occurring in the project area include:

Crustacea

Burnsville Cove cave isopod	Stygobromus conradi	Bath Co., VA
Morrison's cave isopod	Stygobromus morrisoni	Bath, Highland Cos., VA Hardy, Pendleton Cos., WV
Bath County cave amphipod	Stygobromus mundus	Bath, Alleghany Cos., VA
New River riffle crayfish	Cambarus chasmodactylus	New River drainage, VA, WV

INSECTS

Mayflies

West Virginia burrowing mayfly	*Ephemera triplex*	WV

Dragonflies and Damselflies

Alleghany snaketail dragonfly	*Ophiogomphus incurvatus alleghaniensis*	WV, VA

Beetles

Schaum's Blue Ridge ground beetle	*Sphaeroderus shaumi shenandoah*	Stony Man Mtn, Blue Ridge Parkway, VA
Six-banded longhorn beetle	*Dryobius sexnotatus*	VA
Maureen's hydraenan minute moss beetle	*Hydraena maureenae*	Bath Co., VA
American burying beetle	*Nicrophorus americanus*	VA
Black lordithon rove beetle	*Lordithon niger*	VA, WV

Butterflies and Moths

Marbled underwing moth	*Catocala marmota*	VA
Precious underwing moth	*Catocala pretiosa*	VA
Hebard's noctuid moth	*Erythroecia hebardi*	VA
Tawny crescent butterfly	*Phyciodes batesi*	WV
Regal fritillary butterfly	*Speyeria idalia*	VA, WV
Chestnut clearwing moth	*Synanthedon castaneae*	VA

"Candidate" species are not legally protected under the Endangered Species Act and Biological Assessment and consultation requirements pursuant to that legislation do not apply to them. They are included here for the purpose of notifying you of possible future proposals and listings in advance, for consideration in your NEPA review process, and to encourage efforts to avoid adverse impacts to them. Additional information on these candidate species may be obtained by contacting the Virginia Natural Heritage Program (804-786-2121) and the West Virginia Natural Heritage Program (304-636-1767).

This response relates only to endangered species under our jurisdiction. It does not address other Service concerns under the Fish and Wildlife Coordination Act or other legislation.

If you have any questions regarding this response, please contact Andy Moser or Judy Jacobs of my Endangered Species staff.

Sincerely yours,

G. A. Moser

for Glenn Kinser
Supervisor
Annapolis Field Office

enclosures

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES IN VIRGINIA

Common Name	Scientific Name	Status	Distribution
FISHES:			
Chub, slender	*Hybopsis cahni*	T	Powell River, Lee County; Clinch River downstream of TN line. Critical habitat: Powell River, main channel from the Tennessee-Virginia state line upstream through Lee County; Clinch River, TN-VA state line upstream through Scott County.
Chub, spotfin	*Hybopsis monacha*	T	North Fork Holston River, Scott and Washington Counties; Middle Fork Holston River, Washington County. Critical habitat: North Fork Holston River, main channel from the Virginia-Tennessee state line upstream through Scott and Washington Counties.
Madtom, yellowfin	*Noturus flavipinnis*	T	Copper Creek, Scott and Russell Counties; Powell River downstream of TN line. Critical habitat: Powell River, main channel from the Virginia-Tennessee state line upstream through Lee County; Copper Creek, main channel from its junction with Clinch River upstream through Scott County and upstream in Russell County to Dickensville.
Madtom, yellowfin	*Noturus flavipinnis*	X	Experimental populations are designated in North Fork Holston River, Smyth, Washington and Scott Counties.

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES IN VIRGINIA

Common Name	Scientific Name	Status	Distribution
Sturgeon, shortnose*	Acipenser brevirostrum	E	No recent records. Potentially in Chesapeake Bay tributaries.
REPTILES:			
Turtle, green*	Chelonia mydas	T	Oceanic; summer resident in coastal waters, including Chesapeake Bay.
Turtle, hawksbill*	Eretomchelys imbricata	E	Oceanic; summer visitor in coastal waters.
Turtle, leatherback*	Dermochelys coriacea	E	Oceanic; summer visitor in coastal waters, including Chesapeake Bay.
Turtle, loggerhead*	Caretta caretta	T	Oceanic; summer resident in coastal waters, including Chesapeake Bay; occasionally nests in Virginia Beach, Northampton and Accomack Counties.
Turtle, Atlantic ridley*	Lepidochelys kempii	E	Oceanic; summer resident in coastal waters, including Chesapeake Bay.
BIRDS:			
Eagle, bald	Haliaeetus leucocephalus	E	Entire state - nests in eastern counties.
Falcon, American peregrine	Falco peregrinus anatum	E	Entire state - re-establishment of breeding population to coastal and mountain sites in progress.
Falcon, Arctic peregrine	Falco peregrinus tundrius	T	Entire state- migratory; concentration area along coast.

August 1988

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES IN VIRGINIA

Common Name	Scientific Name	Status	Distribution
Plover, piping	*Charadrius melodus*	T	Accomack and Northampton Counties, Cities of Hampton and Virginia Beach.
Warbler, Bachman's	*Vermivora bachmanii*	E	Extremely rare - no recorded nesting.
Warbler, Kirtland's	*Dendroica kirtlandii*	E	Entire state - occasional migrant.
Woodpecker, red-cockaded	*Picoides borealis*	E	Brunswick, Isle of Wight, Prince George, Southampton, Suffolk, Surry, Sussex, Virginia Beach and York Counties.
MAMMALS:			
Bat, gray	*Myotis grisescens*	E	Lee, Scott, and Washington Counties.
Bat, Indiana	*Myotis sodalis*	E	Lee, Wise, Bland, Giles, Botetourt, Montgomery, Alleghany, Bath, Tazewell and Shenandoah Counties.
Bat, Virginia big-eared	*Plecotus townsendii virginianus*	E	Bath, Highland and Tazewell Counties.
Cougar, eastern	*Felis concolor couguar*	E	Historically, entire state; continued existence unconfirmed.
Shrew, Dismal Swamp southeastern	*Sorex longirostris fisheri*	T	Cities of Chesapeake and Suffolk.
Squirrel, Delmarva Peninsula fox	*Sciurus niger cinereus*	E	Accomack and Northampton Counties.
Squirrel, Virginia northern flying	*Glaucomys sabrinus fuscus*	E	Grayson, Highland and Smyth Counties.
Whale, blue*	*Balaenoptera musculus*	E	Oceanic.

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES IN VIRGINIA

Common Name	Scientific Name	Status	Distribution
Whale, finback*	Balaenoptera physalus	E	Oceanic.
Whale, humpback*	Megaptera novaeangliae	E	Oceanic.
Whale, right*	Eubalaena spp. (All species)	E	Oceanic.
Whale, sei*	Balaenoptera borealis	E	Oceanic.
Whale, sperm*	Physeter catodon	E	Oceanic.
MOLLUSKS:			
Snail, Virginia fringed mountain	Polygriscus virginianus	E	Pulaski County, near Radford.
Mussel, birdwing pearly	Conradilla caelata	E	Powell and Clinch Rivers, Lee, Russell, Scott and Wise Counties.
Mussell, green blossom pearly	Epioblasma (=Dysnomia) torulosa gubernaculum	E	Clinch River, Scott County.
Mussel, tan riffle	Epioblasma walker	E	Middle Fork Holston River, Smyth and Washington Counties.
Mussel, fine-rayed	Fusconaia cuneolus	E	Clinch River, Tazewell, Russell, Scott, and Wise Counties; Powell River, Lee County.
Mussel, shiny pigtoe	Fusconaia edgariana	E	Powell, Clinch and Holston Rivers, Tazewell, Russell, Scott, Wise, Lee, Washington and Smyth Counties.
Mussel, little-winged pearly	Pegias fabula	PE	Clinch River, Tazewell County; North and Middle Forks Holston River, Smyth County.

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES
IN VIRGINIA

Common Name	Scientific Name	Status	Distribution
Mussel, Cumberland monkey-face pearly	*Quadrula intermedia*	E	Powell River, Lee County.
Mussel, Appalachian monkey-face pearly	*Quadrula sparsa*	E	Powell River, Lee County; Clinch River, Scott County.
Mussel, pink mucket pearly	*Lampsilis orbiculata*	E	Clinch River, Scott County.
Spinymussel, James	*Pleurobema collina*	E	Craig, Johns, Catawba Creeks, Craig and Botetourt Counties.
ARTHROPODS:			
Isopod, Madison Cave	*Antrolana lira*	T	Augusta County.
Amphipod, Hay's Spring	*Stygobromus hayi*	E	District of Columbia.
PLANTS:			
Birch, Virginia round-leaf	*Betula uber*	E	Cressy Creek, Smyth County.
Pink, swamp	*Helonias bullata*	PT	Augusta, Henrico, and Nelson Counties.
Pogonia, small whorled	*Isotria medeoloides*	E	Appomattox, Buckingham, Caroline, Gloucester, James City, New Kent, and Prince William Counties.
Mallow, Peter's mountain	*Iliamna corei*	E	Giles County.

*Except for sea turtle nesting habitat, principal responsibility for these species is vested with the National Marine Fisheries Service.

PE - Proposed Endangered
E - Endangered
T - Threatened
PX - Proposed Experimental Population

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES IN WEST VIRGINIA

Common Name	Scientific Name	Status	Distribution
FISHES:			
None			
BIRDS			
Eagle, bald	*Haliaeetus leucocephalus*	E	Entire state; nests in Grant and Hardy Counties
Falcon, American peregrine	*Falco peregrinus anatum*	E	Entire state - migratory
Falcon, Arctic peregrine	*Falco peregrinus tundrius*	T	Entire state - migratory; no nesting
Warbler, Kirtland's	*Dendroica kirtlandii*	E	Entire state - occasional migrant
MAMMALS			
Bat, Indiana	*Myotis sodalis*	E	Entire state - known hibernacula in Tucker, Pocahontas, Preston and Pendleton Counties - critical habitat Hellhole Cave, Pendleton County
Bat, Virginia big-eared	*Plecotus townsendii virginianus*	E	Primarily northeastern, especially Pendleton, Tucker and Grant Counties. Critical habitat Hellhole Cave, Cave Mountain Cave, Hoffman School Cave, ad Sinnit Cave in Pendleton County; Cave Hollow Cave in Tucker County
Squirrel, Virginia northern flying	*Glaucomys sabrinus fuscus*	E	Pocahontas, Pendleton and Randolph Counties
Cougar, eastern	*Felis concolor couguar*	E	Historically, entire state; continued existence unconfirmed

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FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES IN WEST VIRGINIA

Common Name	Scientific Name	Status	Distribution
MOLLUSKS			
Snail, flat-spired three-toothed land	Triodopsis platysayoides	T	Monongalia County
Mussel, tuberculed-blossom pearly	Epioblasma (=Dysnomia) torulosa torulosa	E	Kanawha River, Fayette County
Mussel, pink mucket pearly	Lampsilis orbiculata	E	Kanawha River, Fayette County and Ohio River, Cabell County
Mussel, James spiny	Pleurobema collina	E	Potts Creek, Monroe County
PLANTS			
Clover, running buffalo	Trifolium stoloniferum	E	Alluvial plains, Fayette and Webster Counties
Harperella	Ptilimnium nodosum	PE	Morgan County

E = Endangered
T = Threatened
PE = Proposed Endangered
PT = Proposed Threatened

Table B-1.--Biological evaluations of Federally-listed, proposed or category 1 species known to occur in AIPM Project Area.

Virginia Northern Flying Squirrel

Potential adverse effects on:	from:	how:	Effects analyzed and measures established in:
habitat	gypsy moth outbreaks	-changes in forest structure and composition	Project Environmental Assessment
		-possible reduction of food supplies	Project Environmental Assessment

Virginia Big-eared Bat and Indiana Bat

Potential adverse effects on:	from:	how:	Effects analyzed and measures established in:
food supply	gypsy moth outbreaks	-possible reductions of some food supplies	Project Environmental Assessment
food supply	Bt or diflubenzuron	-reductions of some food supplies	Project Environmental Assessment

Bald Eagle

Potential adverse effects on:	from:	how:	Effects analyzed and measures established in:
nest sites	gypsy moth outbreaks	-habitat alteration during critical nesting periods	Project Environmental Assessment
nest sites	aerial applications	-disturbances during critical nesting periods	Mitigation Measures - AIPM EIS
nest sites	other human activities	-disturbances during critical nesting periods	Mitigation Measures - AIPM EIS

Peregrine Falcon

Potential adverse effects on:	from:	how:	Effects analyzed and measures established in:
eyries	human activities	-disturbance	Project Environmental Assessment

Table B-1.--Biological evaluations of Federally-listed, proposed or category 1 species known to occur in AIPM Project Area (continued).

Cheat Mountain and Shenandoah Salamanders

Potential adverse effects on:	from:	how:	Effects analyzed and measures established in:
habitat	gypsy moth outbreaks	-changes in habitat suitability	Project Environmental Assessment

Flat-spired Three-toothed Snail

Potential adverse effects on:	from:	how:	Effects analyzed and measures established in:
physiology	diflubenzuron	-unknown	Mitigation Measures - AIPM EIS

Madison Cave Isopod

Potential adverse effects on:	from:	how:	Effects analyzed and measures established in:
water quality	gypsy moth outbreaks	-defoliation related effects on water quality	Project Environmental Assessment
physiology	diflubenzuron	-unknown	Mitigation Measures - AIPM EIS

Plants (Harparella, Running Buffalo Clover, Shale Barren Rockcress, Swamp Pink)

Potential adverse effects on:	from:	how:	Effects analyzed and measures established in:
physiology	gypsy moth outbreaks	-unknown effects of defoliation	Project Environmental Assessment
habitat	gypsy moth outbreaks	-changes in site conditions	Project Environmental Assessment
individuals	human disturbance	-trampling	Mitigation Measures - AIPM EIS

APPENDIX C

APPENDIX C

APPENDIX C

PLAIN LANGUAGE SUMMARY OF THE HEALTH RISK ANALYSIS FOR DIFLUBENZURON

INTRODUCTION

This appendix is extracted from the plain language addendum of the Gypsy Moth Suppression and Eradications Projects, Final Environmental Impact Statement. For detailed information on how the risks were calculated or methods used, the reader is referred to Appendix F of the FEIS.

OVERVIEW

Only one chemical insecticide, diflubenzuron, is being considered for use in the AIPM projects to suppress gypsy moths. Appendix C analyzes the risk to human health of using diflubenzuron.

This appendix is for the general reader. It describes the methods and results of the risk analysis in words that can be understood by decision-makers and the public. Readers who want to check the mathemathics or see what studies were used should refer to the Final Environmental Impact Statement, Appendix F (USDA FEIS 1985).

Conclusions

The chemical being considered is diflubenzuron. The basic question being asked in the risk analysis is, would human health be affected by use? Briefly, the answer is as follows:

1. All realistic doses to the general public from routine spraying would be unlikely to pose any significant risks of adverse effects, based on evaluations of this chemical made by the Environmental Protection Agency (EPA) or the World Health Organization.

2. All exposures from routine operations would be well below levels that could cause birth defects in the general population.

3. Realistic doses to workers from routine operations would have no ill effects.

4. The estimated doses from abnormally high exposures (worse case doses) in routine operations would be below the "safe" levels. That is, they would be below the acceptable daily intake levels.

5. Some people who are unusually sensitive to chemicals could be affected by the routine spraying of diflubenzuron. These people should be warned of possible harm before spraying takes place.

6. In most cases, aircraft spills would have no lasting effects on human health.

7. The odds of a person getting cancer from routine operations are estimated to be one in a billion.

8. The total added risk of cancer from routine operations would be 0.05 incidence per year in the exposed population of 5.4 million people. This figure is based on the amounts that have been sprayed in the past.

9. It is extremely unlikely that spraying projects would result in mutations that could be passed to offspring.

Method

These conclusions were reached by using a three-step process used in most risk analyses:

1. Hazard Identification

   a. What are the toxic (poisonous) properties of the chemical?

   b. What doses are deemed safe for humans?

   c. What doses might cause harm?

   Most of this information comes from laboratory tests that used mammals. Other sources include studies of human poisonings and research involving other organisms.

2. Exposure Analysis

   a. Who is likely to be exposed as a result of spraying?

   b. How much of the chemical is likely to enter their bodies?

   c. How often will they be exposed?

   People can be exposed in several ways and can take in different amounts of the chemical. The exposure analysis describes the ways people might be exposed. These situations, called "scenarios", range from properly handled routine operations, through the worst cases that could occur during routine applications, to accidental spills of chemical concentrates. These scenarios cover a wide range of possible exposures so any real life exposure should be close to or less than these.

3. Risk Evaluation

   a. How will human health likely be affected by actual spraying operations?

      This is answered by comparing the results of the first two steps. That is the estimated doses (the amounts that might enter people's bodies) in the different exposure scenarios are compared with the doses found to be safe or harmful to health.

   It must be remembered that exposure to insecticides almost always involves some element of risk. Therefore, the risk evaluation discusses degrees of risk (or the odds that significant risks will or will not occur) rather than absolute safety versus unacceptable risks.

Use of Worst Case Assumptions

Whenever there is doubt about what might happen when the chemical is used, this analysis assumes the worst. For instance, if there is doubt that diflubenzuron can cause cancer, this analysis makes the worst case assumption that it can. Another

example is that all standard application rates are increased by 10 percent to account for normal variations in preparing and spraying the chemical. In the worst case scenarios, these rates are increased by 100 percent to account for possible major errors in mixing and spraying. It is also assumed that a person might eat fruit or vegetables that contain spray residues, even though spraying is done some time before most fruit and vegetables would be harvested. Further, the amount of food in an exposed person's diet is assumed to be greater than it is in the average diet.

Together, the worst case assumptions help ensure that health risks will not be understated. But in doing so, they probably suggest that the spraying projects pose greater risks than are likely. In other words, the risks listed above probably are exaggerated. For example, use of worst case assumptions suggests that there is a small risk of cancer occurring. Yet there is no evidence that diflubenzuron can cause cancer in humans or other vertebrates at any dose levels.

The following sections discuss the methods and conclusions of the health risk analysis in greater detail.

HAZARD IDENTIFICATION

Determining Toxicity

The first step in the risk analysis is to determine the toxicity of diflubenzuron. Toxicity is the ability of a substance to harm health.

Diflubenzuron has been studied in the laboratory using conventional toxicity tests on animals. It is standard practice in the health field to use the results of such tests to help determine hazards to people. This is because different animals, including humans, often react similarly when given similar doses of a substance. But this is not always the case. Therefore, good judgment and care must be used when applying the results of animal tests to humans.

Health effects caused by toxic chemicals fall into two groups: threshold responses and nonthreshold responses. Most obvious effects, such as birth defects and nervous disorders, seem to fall into the first group. Cancer and mutations (changes in body cells) fall into the second group. But it is not the types of diseases that separate the two groups. Rather, it is the way in which the responses occur.

With threshold responses, there is a certain amount of the substance that can enter the bodies of most animals or humans without causing any harm. The dividing line between doses that have no effects and those that do is the threshold level. Once the threshold is crossed, increased doses will increase the intensity and extent of the effects. In theory at least, these types of responses are fairly predictable and similar in all healthy people.

With nonthreshold responses, any dose might set off a reaction, but there is no certainty that it will do so. There will be an adverse effect only if the chemical successfully invades the body and reaches certain strategic points, such as the DNA in human cells. It is possible for a large dose of the substance to enter a person's body without any effect at all. But the greater the lifetime dose, the greater the odds of seeing these effects.

Threshold Responses

Animals and people do not show threshold responses until certain doses are exceeded. Therefore, to assess health risks from a chemical, it would seem necessary to find

out its threshold dose. That is, how much of the chemical will the body tolerate before there are ill effects. This threshold dose cannot be known precisely without running a seemingly endless series of tests using slightly different doses. So toxicologists instead focus on the highest doses that are known to cause no ill effects. These doses are called no-observed-effect levels (NOELs).

No-observed-effect levels for chemicals are determined in standard, controlled lab tests. In these tests, a population of animals (such as mice of roughly the same age) is separated into groups. Each group then is given a different daily dose of the substance for an extended period of time. The highest does that has no apparent ill effects is the NOEL.

To compare doses given to different species or different sized animals, a common unit is needed for measuring doses. Sometimes doses are based on body weight. At other times, doses are based on the surface area of the body. In this study, doses are expressed as fractions of body weight. The standard unit is milligrams (of chemical) per kilogram (of body weight). One kilogram is equal to 2.2 pounds, while a milligram weighs one million times less. When the dose is given daily, as is the case with most NOELs, the unit is milligrams per kilogram per day (mg/kg/day).

There may be several NOELs for each chemical--both for different species and different responses. While different species of mammals, including humans, tend to respond similarly to the same dose of a chemical, they do not respond identically. Furthermore, toxicity tests often look for specific types of responses (such as birth defects) and might overlook others. Figure C-1 shows a hypothetical example of a substance with several NOELs. This hazard analysis tried to focus on the lowest NOEL for diflubenzuron to make sure that risks would not be understated.

As suggested in figure C-1, once the dose of a substance exceeds the NOEL and crosses the threshold, the effects tend to increase as the dose increases. The increase in effects can take two forms; an increase in intensity (such as increasing kidney problems), or the addition of new types of effects (for example, birth defects in addition to kidney problems). The first effects might be relatively mild and, even then, result only after long-term exposure. But as the dose increases, the effects would become more severe.

The most severe effect from a toxic substance is death, with the most extreme effect being death from a single (acute) exposure. The one-time or short-term dose that kills 50 percent of a group of treated lab animals is called the LD_{50} (for "lethal dose, 50 percent"). An oral LD_{50} is the lethal dose from swallowing a chemical. A dermal LD_{50} is the lethal dose on unbroken skin. Clearly, a person would be at great risk if exposed to a substance at a level near its LD_{50}.

Because of biological differences between test animals and humans, NOELs cannot be responsibly applied to humans without using a safety factor. That is, to err on the side of caution, NOELs from animal studies usually are reduced by a safety factor to set safe doses for humans. The most common safety factor is 100, but it can range from 10 to 1,000. The U.S. Environmental Protection Agency and the World Health Organization both use safety factors to establish safe doses for various chemicals. For each chemical, the safety factor used depends on how sure they are that the available studies can be applied to humans. The term they use for safe dose is "acceptable daily intake (ADI)." The ADI is believed to be the maximum dose of the chemical that can be taken every day over a person's lifetime without any adverse effects. Figure C-2 shows the relationship between NOELs, ADIs and LD_{50}s. ADIs are the starting points used to evaluate the health risks associated with each chemical. If the exposure analysis shows that the expected dose to humans will be

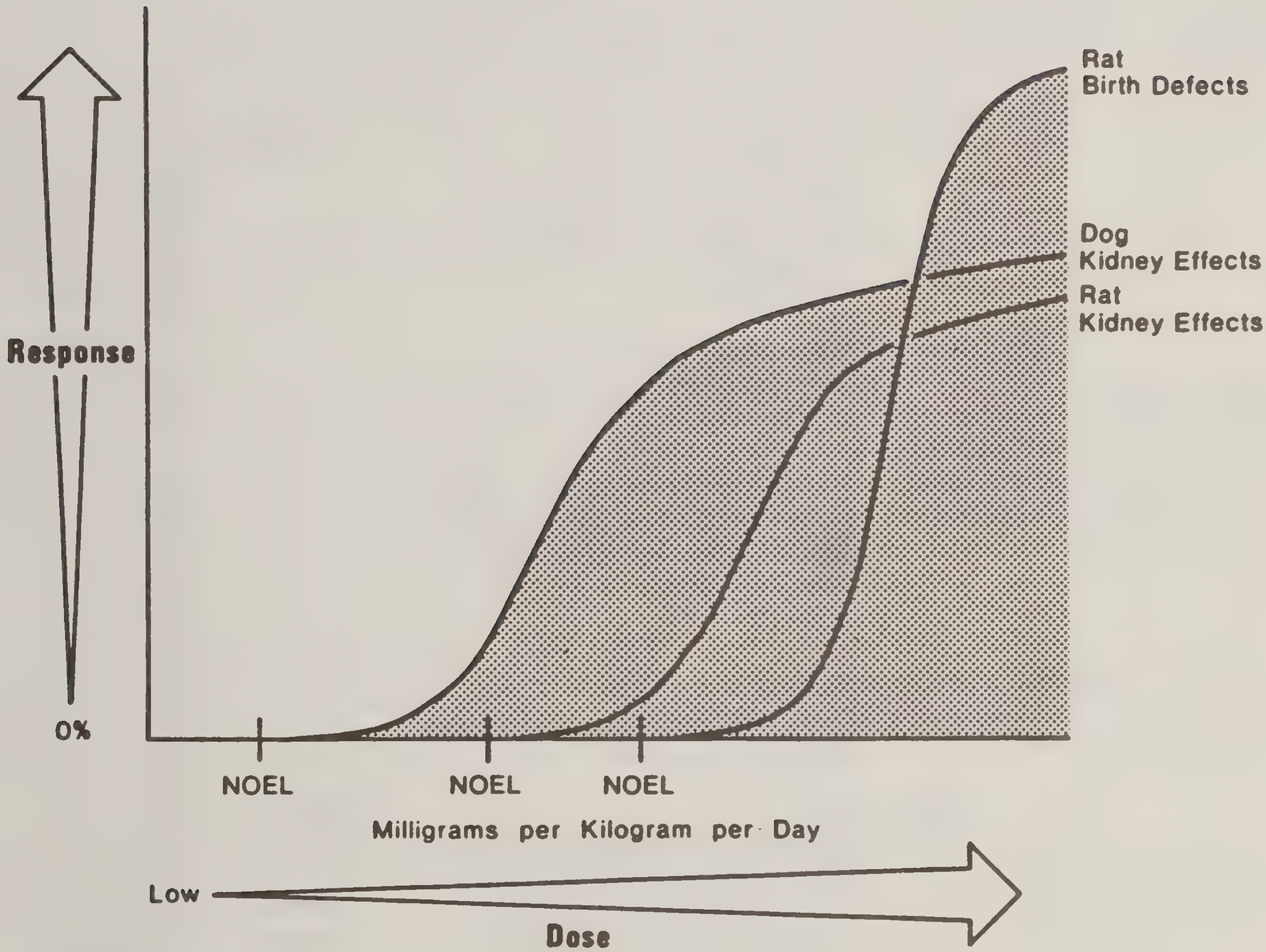

Figure C-1.--Typical dose-response pattern fromthreshold responses. This example shows a chemical with three no-observed-effect levels (NOELs). The lowest NOEL is for kidney effects in dogs. The intensity of this effect increases as the dose increases. Even larger doses could result in birth defects in addition to kidney problems. (The two NOELs for kidney effects show how one species might be more sensitive than another to the same chemical.

LD_{50} - Acute lethal dose. One-time or short-term dose that is lethal to 50 percent of treated animals.

Threshold - Long-term dose level at which adverse effects first occur.

NOEL - No-observed-effect level. Long-term dose that does not result in apparent adverse effects in test animals.

Safety Factor - Factor applied to the NOEL to set safe lifetime dose to humans.

ADI - Acceptable daily intake. Maximum dose that a person could safely take every day throughout lifetime without harm to health.

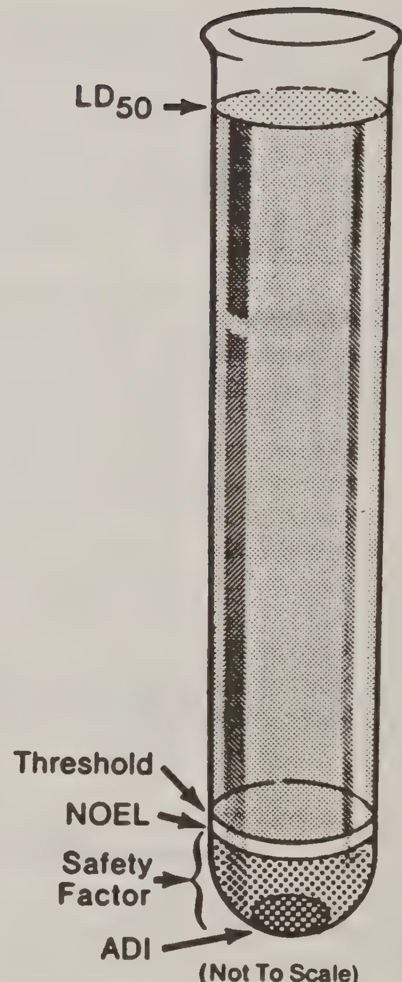

Figure C-2.--Relationship between doses seen in laboratory tests and established safe doses (acceptable daily intakes) for humans.

less than the ADI, then the dose is considered safe for most people. For doses above the ADI, it is necessary to look more closely at the data about the chemical. Specifically, it is necessary to determine the margin of safety--that is, to see how close the dose is to the various NOELs. It is necessary to look at the type of responses that might be involved. If the expected dose occurred every day for a long period and approached the NOEL for a harmful response that is not easily cured, then the safety margin would be small and the health risk might be great. In such situations, a responsible decision-maker would want a high margin of safety before using the chemical. It must be kept in mind that the NOELs used in this analysis are from studies that involve daily exposure over a long time. Also, ADIs are considered to be doses that can be taken safely every day for an entire lifetime. Yet most potential exposures from gypsy moth projects are one-time or short-term exposures. Therefore, comparing the estimated exposures to ADIs and NOELs might not give a true picture of the risks involved. Any error would overstate the risks.

Nonthreshold Responses

Scientists do not all agree about the link between human exposure to chemicals and the occurrence of mutations or cancer. But generally it is thought that no threshold levels are involved.

Cancer. Doctors usually do not speak of degrees of cancer; a person either has cancer or does not. The chance of getting cancer has been compared to the chance of being hit by a car when crossing a road blindfolded. Even if there is only one car within 100 miles, there is a small chance it will hit. If there are two cars, the chances will be greater, and so on. Likewise, the odds of getting cancer from a known carcinogen (cancer-causing substance) increase with the size and duration of the dose.

Hazard assessments for cancer have two steps. The first is to see if there is evidence that a chemical could cause cancer. The second is to find the odds of getting cancer from different doses. Since there are no known cases of human cancer being caused by diflubenzuron, data on animals were used. A mathematical model was used to determine its cancer potency.

Various models (or formulas) can be used to determine cancer potency. For this study, a simple linear model was used. The linear model assumes that a steady increase in dose will result in a steady increase in the odds of getting cancer. This model is overly simplistic, but it usually errs on the side of overstating the chances of cancer occurring.

The linear model also assumes that a given total dose will have the same effect no matter what the dosing period is. For example, a large dose given on one day is assumed to have the same effect as the same total dose given in smaller amounts over several days. However, this may not always be the case. So this assumption puts some uncertainty into the risk analysis.

An example of the assumed linear relationship between a dose of a specific substance and the chance of cancer is shown in figure C-3. To show how the linear model overstates the effects of low doses, the graph includes a curve that is closer to known cancer potencies.

The straight-line slope in figure C-3 represents cancer potency. It shows that the increase in cancer probability is for each increase in dose. If the slope were steeper, then the cancer potency would be greater. The potency slope also can be

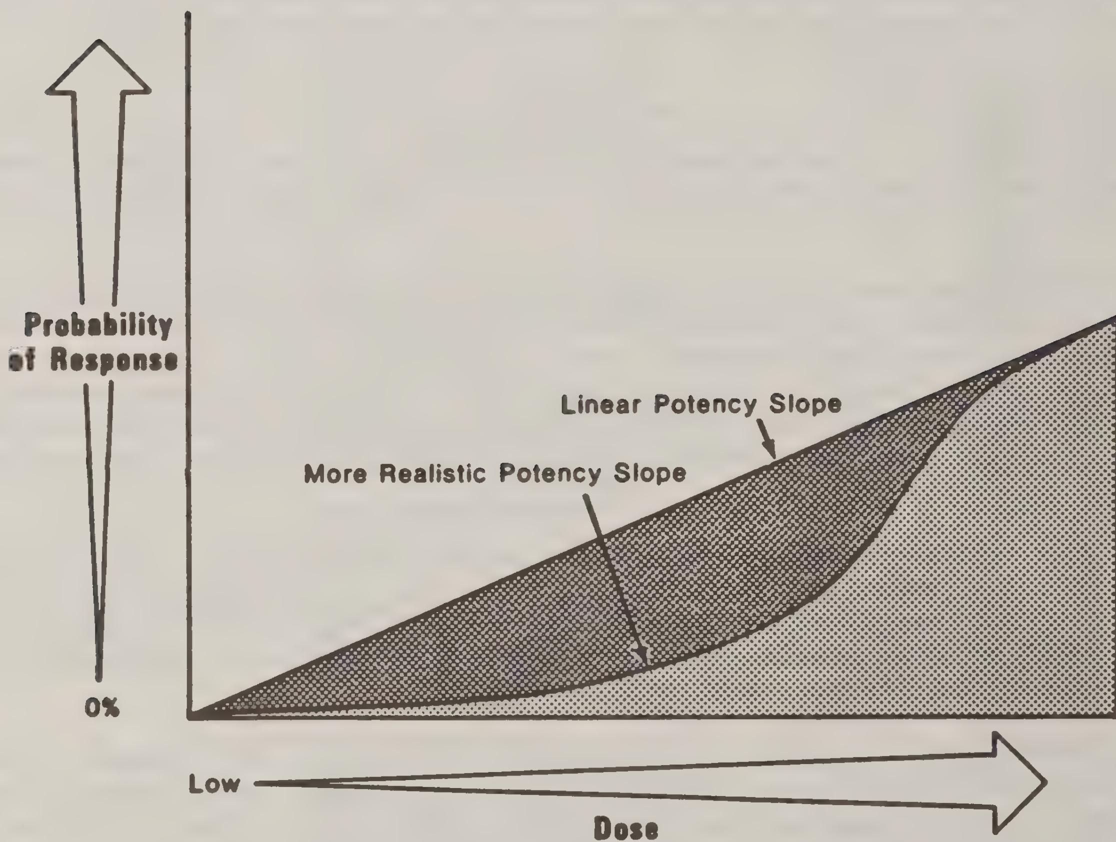

Figure C-3.--Relationship between dose and probability of cancer assumed in linear model. The curved line represents a more realistic potentency slope. The darker shaded area suggests how the linear model overstates the effect of low doses.

expressed as a number; the higher the number, the more potent the carcinogen. Because potency slopes and values can be difficult to grasp, this summary also indicates that a daily dose of diflubenzuron would result in a one in a million chance of getting cancer.

Heritable Mutations. Cancer is the end result of a multi-step process that starts with mutations (changes) in body cells. Changes in most body cells might lead to cancer. But changes in most cells cannot be inherited by offspring. Cells involved in reproduction--called germ cells--are another matter. Mutations in these cells can be inherited. Some of these changes may be minor, but others can be quite serious.

At this time, there are no generally accepted mathematical models for determining the risk of mutations. Instead, scientists weigh the evidence from various laboratory tests to try to assess the ability of a chemical to cause mutations in humans. Such a "qualitative" picture is incomplete; it indicates whether the chemical can cause heritable mutations (those that can be passed to offspring), but it cannot quantify the risks for humans.

However, it may be safe to assume that the risk of heritable mutations would be no greater than the risk of cancer. The mechanisms that distinguish cancer development from the development of mutations are not fully understood. Various factors have been identified that could cause cancer or heritable mutations. The main difference is that substances that cause cancer have many more possible targets in the body. While cancer is caused by changes in any cell, heritable mutations are caused only by changes in germ cells. Thus, use of the linear cancer model (which overstates the risk of cancer) to estimate the risk of heritable mutations would grossly overestimate such risks.

Hazard Levels of Diflubenzuron

Diflubenzuron is currently registered by the Environmental Protection Agency for the control of gypsy moth larvae. This means that, in EPA's judgment, available studies indicate that diflubenzuron is not likely to cause unreasonable adverse effects in people or the environment when properly used.

The acceptable daily intakes, no-observed-effect levels, and acute lethal doses are presented in table C-1. The following subsection summarizes the toxic properties of diflubenzuron. (More detailed information can be found on pages 61 to 64 of the FEIS, on pages F-12 to F-22 of Appendix F, and on pages I-1 to I-22 of appendix I) (USDA FEIS 1985).

Threshold Responses. Diflubenzuron is selective in its toxicity. It causes the outside skelton of insects to rupture when they molt. It is considered to be only slightly toxic to humans. There is no evidence that diflubenzuron causes birth defects. The main health concern is that diflubenzuron is known to raise the levels of sulfhemoglobin and methemoglobin in blood. This effect could impair the bloodstream's ability to carry oxygen. Based on the results of a long term (2-year) feeding study on rats, the EPA has raised the ADI from 0.011 to 0.02 mg/kg/day.

In the rat study, the highest dose at which no methemoglobinia was observed was 40 mg/kg(=2 mg/kg body weight). Additional studies in cats and dogs have confirmed

Table C-1.--Comparison of no-observed-effect levels, acceptable daily intakes, acute lethal doses, and cancer potencies of diflubenzuron used in the risk analysis.

Benchmark	Diflubenzuron
	Milligrams per kilogram of body weight
Dermal LD_{50}	2,000[a]
	Milligrams per kilogram of body weight per day
Lowest NOEL	1.1[a]
Lowest Birth Defect NOEL	4,000[a]
ADI	0.02
One-In-A-Million Cancer Probability[b]	0.000052
	Per milligram per kilogram per day over a lifetime
Cancer Potency	0.019[c]

[a]Highest dose tested; actual number would be higher.

[b]Lifetime daily dose that would result in a one-in-a-million chance of person getting cancer from this chemical alone.

[c]Diflubenzuron itself is considered to be noncarcinogenic; statistic is for 4-chloroaniline, which can be produced when diflubenzuron breaks down.

this figure. This NOEL was used to calculate the current ADI in man (0.02 mg/kg/day), using an additional safety factor of 100. For a 154-pound person, this "safe dose" would be 1.40 milligrams per day.

Nonthreshold Responses. Laboratory studies indicate that diflubenzuron does not cause mutations or cancer. But there might be some risk of cancer associated with exposure to this chemical because one of its breakdown products, 4-chloroaniline, might cause cancer. The evidence about 4-chloroaniline is suggestive, not conclusive. But this analysis makes the worst case assumption that 4-chloroaniline can cause cancer in humans. The cancer potency (calculated in Appendix F, USDA FEIS 1985) would range from 0.0036 to 0.034. Based on a potency of 0.019 (a midpoint average for cancer potency), a 154-pound man would have to be exposed to about 0.0036 milligram of 4-chloroaniline per day throughout his life to have a one-in-a-million chance of getting cancer from this chemical. For diflubenzuron to be the source of this exposure, something like the following would need to occur: every day of his life, the man would have to eat an entire fish that had been exposed to 0.01 milligram of diflubenzuron.

Exposure Analysis

For an insecticide to cause harm to a person, two conditions must be met. First, the substance must be in the person's environment. Second, it must enter the body. Exposure to an insecticide must come from the air that a person breathes, the water the person drinks, or the food the person eats, or the chemical must come into contact with the skin. The amount of chemical in a person's environment is the exposure level.

If the chemical is in the air, it can enter the body through the air passages and lungs (called the inhalation route). If it is on a person's clothes or skin, it must pass through the skin to enter the body (the dermal route). A chemical also could get into the body if the person eats food or drinks water that has insecticide residues (the ingestion, oral, or dietary route). The total amount that actually enters the body is called the dose.

In gypsy moth projects, two groups of people can be exposed. The first group is workers. This group includes supervisors, pilots, truck driver, mixer/loaders, and observers (including inspectors, scouts, rangers, and ecologists). The second group includes members of the general public living in or near sprayed areas.

To find out how much of the chemical these groups could be exposed to, all likely ways a person could be exposed were identified. Then doses from these exposure routes were estimated using standard methods and assumptions. These doses, along with information from the hazard identification section, are used in the risk evaluation section to assess the health risks to workers and the public from exposure to the insecticides.

Possible Routes of Exposure

To cover most ways a person could be exposed, a set of situations, called "scenarios," is used. These range from situations that possibly could occur during routine spraying operations to an unlikely event, such as accidental spills.

Exposures from Routine Spraying Operations

Workers and the public can be exposed to the insecticides in two ways: directly and indirectly. Direct exposures are when the chemical comes into contact with the skin or a person breathes the spray. As discussed on page F-34 of Appendix F (USDA FEIS 1985), inhalation exposures from spraying operations are insignificant. Thus, observers who happen to be under the spray plane or mixer/loaders who splash the chemical on their hands would get direct exposures. Direct exposure also can come from spray drift.

Indirect exposure comes from touching sprayed things like yard furniture or tools that have residues on them. Indirect exposure also can come from eating meat or vegetables or drinking water that have insecticide residues. Figures C-4 and C-5 show the possible routes of exposure from routine operations.

Exposures from Accidents

The highest exposures to workers and residents could come from large amounts of insecticide accidentally spilled from an aircraft (an airplane or helicopter) or a truck. If the mixture is spilled onto a person, the primary route of exposure would be through the skin. If it is spilled into a stream or other body of water, the

Exposure Scenario	Routes of Exposure
Mixer/loaders	All routes of exposure (dermal, inhalation, and ingestion).
Observers	All routes of exposure.

Figure C-4.--Possible routes of exposure to workers from routine gypsy moth control projects.

Exposure Scenario	Routes of Exposure
Direct	Dermal and inhalation exposure from being outside during a spray operation plus dermal exposure from contact with things like plants, grass, or outdoor furniture.
Indirect	No direct dermal exposure (person is inside during spraying) but indirect exposure from contact with items that have insecticide residues.
Dietary	Ingestion exposure from eating about a pound of fish or meat, a pound of vegetables or fruits, and drinking about a half gallon of water--all of which have insecticide residues.

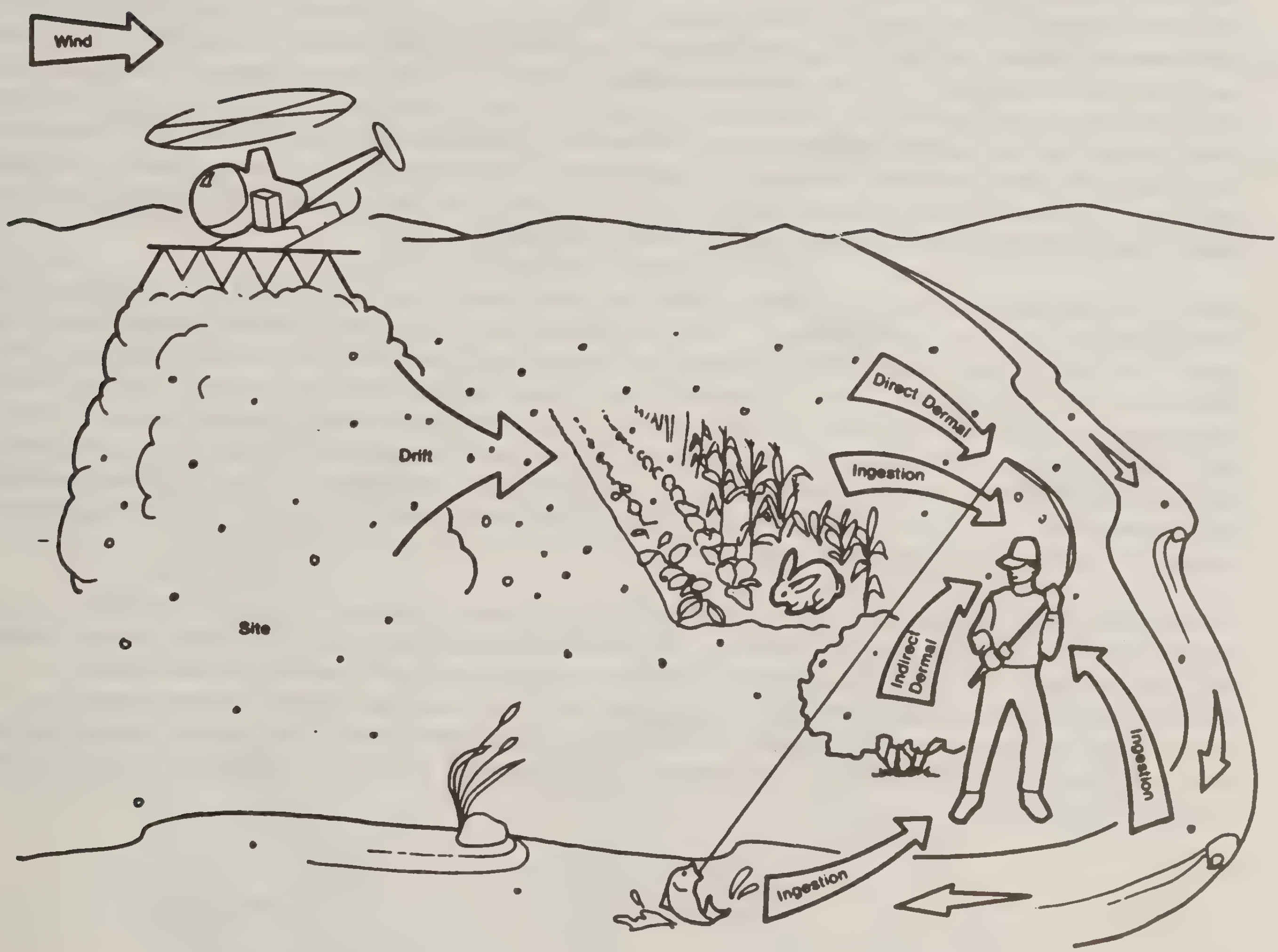

Figure C-5.--Possible routes of exposure to the general public from routine gypsy moth control projects.

route would be by drinking water or eating fish from that stream. Possible routes of exposure from accidents are shown in figure C-6.

Estimating Doses

For exposure to diflubenzuron in each scenario, a range of doses was obtained. Realistic doses are levels that might realistically occur during routine spraying. Worst case doses are very high estimates of the most a person might get in that scenario. These exposures are based on assumptions that fit the real world (that is, that are plausible) but that always overestimate risk. Certain actions, such as warning people about spraying operations and making sure that spraying takes place only under the right weather conditions, would reduce the likelihood of worst case doses.

Most of the doses in this assessment are based on field studies where carbaryl, another insecticide, was used in actual gypsy moth spraying operations. These studies provide a range of dose levels that actually occurred to both workers and residents during spraying operations. Because diflubenzuron is applied in a similar way and the exposure routes are expected to be similar, the carbaryl studies are the best source available for estimating doses in this analysis. But there are some uncertainties in using this method because diflubenzuron has different properties. For example, the amount of time it takes for the chemical to break down, or degrade, varies. In addition, the amount of chemical on the skin that will enter into the body (called the dermal absorption rate) varies.

Thus, in extrapolating the doses from the carbaryl studies to diflubenzuron, these differences must be considered. For example, a 10-percent dermal absorption rate is used for both chemicals even though the estimated absorption rates for each of the chemicals may be lower. In this way, no risks are underestimated. The different degradation rates also are accounted for when determining lifetime doses. The application rate (the amount of active ingredient of chemical applied per acre) is also considered in determining doses. The application rate used in this analysis for diflubenzuron is 0.06 pound active ingredient per acre or twice the rate which is normally used in suppression projects.

After the basic dose for the two chemicals in each scenario was calculated, it was adjusted to account for variations in mixing and application. "Realistic" doses are multiplied by 1.1 to account for normal variations that can increase doses. "Worst case" doses are multiplied by 2.0 to account for abnormal variations that can cause major differences in the amount of spray being deposited. For more detail on mixing and application variations, see pages F-45 through F-47 of Appendix F of the FEIS (USDA FEIS 1985).

Exposure Scenario	Routes of Exposure
Aircraft Spill	
Partial Dermal	Dermal exposure from the spill of a load of insecticide on a person that enters the body only through those areas not covered by clothes.
Full Dermal	Dermal exposure from aircraft spill that enters the body through exposed skin plus through soaked clothes.
Drinking Water	Ingestion exposure from drinking a half gallon of water from a stream where an aircraft spilled 300 gallons.
Eating Fish	Dietary exposure from eating a pound of fish from the site of a 300-gallon spill.
Truck Spill	
Dermal	Dermal exposure from a truck spill that results in 1 gallon of chemical on the skin.
Drinking Water	Drinking a half gallon of water from a stream that had 2,000 gallons of insecticide mixture spilled into it.
Eating Fish	Eating a pound of fish from a stream in which 2,000 gallons of insecticide had been spilled.

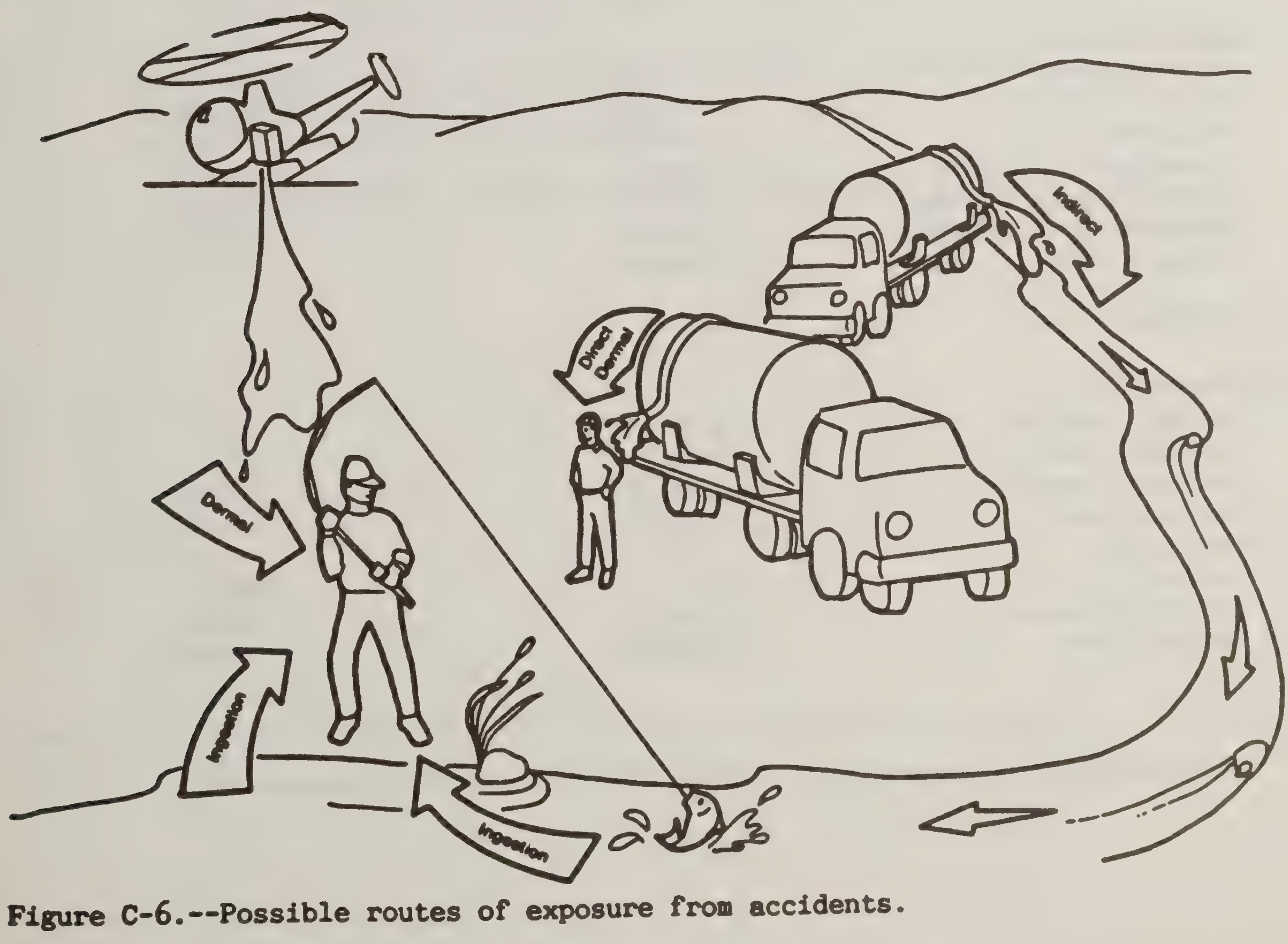

Figure C-6.--Possible routes of exposure from accidents.

The estimated realistic and worst case doses for all exposure scenarios are shown in table C-2.

Doses from Routine Operations

Table C-3 summarizes how the realistic and worst case doses were estimated for each scenario for routine operations. (Pages F-27 through F-43 in Appendix F provide specific details about how these doses were determined.) All doses to the public overestimate risk because, in calculating these initial doses, it was assumed that diflubenzuron does not degrade (that is, its level does not decline over time) at all. Thus, the doses for each scenario are the highest that could be expected.

The dietary dose is the only dose not based on the carbaryl studies. This dose is calculated based on insecticide residue levels found in meat, fish, vegetables, and water. Realistic and worst case doses from residues in vegetables and fruits were based on studies of residue levels from agricultural applications of these chemicals.

Table C-2.--Estimated exposure scenarios (milligrams per kilogram per day) to diflubenzuron.

Exposure Scenario	Realistic Doses	Worst Case Doses
ROUTINE OPERATIONS		
Workers		
Mixer/loaders	0.0028	0.012
Observers	0.00013	0.0035
General Public		
Direct	0.00013	0.0006
Drift	0.000087	0.00032
Indirect	0.000026	0.00011
Direct plus dietary	0.00072	0.0079
Indirect plus dietary	0.00061	0.0074
Observer plus dietary	0.00072	0.01
Dietary only	0.00059	0.0073
ACCIDENTS		
Aircraft spill		
Dermal (partial)	2.3	4.3
Dermal (full)	3.5	6.4
Drinking water	0.0015	0.0028
Eating fish	0.00014[a]	0.00025[a]
Truck spill		
Dermal	430	780
Drinking water	0.01	0.018
Eating fish	0.00091[a]	0.0017[a]

[a]Dose is from 4-chloroaniline, a breakdown product of diflubenzuron.

Table C-3.--Methods for estimating doses from routine operations

Scenario	Realistic Dose	Worst Case Dose
Workers		
Mixer/loader	Based on urine levels in mixer/loaders from carbaryl studies. High range (not average) used.	Based on highest dose level (from urine) from carbaryl studies, as well as studies on other pesticides.
Observer	Based on dose level (from urine) in observers in carbaryl studies.	Assumes observer sprayed directly on 2 square feet of exposed skin.
General Public		
Direct	Based on average exposure levels for residents found in carbaryl studies.	Based on highest exposure level to residents reported in the carbaryl studies.
Drift	Dermal dose based on drift found offsite in a number of relevant studies; two-thirds of the amount deposited onsite gets offsite under routine assumptions.	Dermal dose based on two-thirds of amount deposited onsite under worst case assumptions (for example, application rate is multiplied by 2).
Indirect	Based on lowest dose found for observers in carbaryl studies.	Based on highest dose found for observers in carbaryl studies
Dietary	The estimated dietary exposure level is the sum of the following: eating a pound of meat (from two sources), fish, and vegetables and drinking a half gallon of water--all of which have insecticide residues.	
	Goat/Rabbit--Goats and rabbits are exposed through both dermal and inhalation routes.	Goats and rabbits are exposed to very high levels of insecticide.
	Fish--Based on residue levels found in actual field test of water intentionally directly sprayed with carbaryl.	Based on direct application to stream 6 inches deep with no dilution.
	Vegetables--Based on the low range of residue data from agricultural applications assuming vegetables are picked and eaten the same day as treatment.	Based on high range of residue data from agriculture applications.
	Water--Concentration in water calculated by the same method as for fish residues.	

To receive the multiple exposures under the dietary scenario, a person would have to gather and eat the food or drink the water right after the spraying. Although some fruits and vegetables are growing during the spring when gypsy moth spraying occurs, none are mature enough at that time to be harvested. In addition, insecticide residues in vegetables degrade rapidly within 1 or 2 weeks. Thus, the likelihood that people would get doses from eating vegetables or fruit with insecticide residue is very low. But to ensure that even this remote possibility is considered, doses from this food source are included in the dietary dose.

To determine the highest cumulative doses a person could get from all sources, some doses were combined. For example, the dietary dose was added to the direct, indirect, and observer doses to show the most the general public could be exposed to during routine operations.

Doses from Accidents

If an aircraft or truck spilled insecticide, workers and the general public could be exposed to much more than they would under routine circumstances. However, such accidents are rare. (The probability of such accidents occurring which are based on State and Forest Service records of such events, is discussed in more detail in the risk evaluation section). The assumptions and methods used to determine accidental doses are discussed on pages F-52 through F-55 of Appendix F (USDA FEIS 1985).

Aircraft Spills. For aircraft spills, doses are calculated for dermal exposure and for drinking water and eating fish that have insecticide residues. The load dumped is assumed to be 300 gallons. This is the size of the load typically used in gypsy moth spraying. This load could spill over land or into water. Exposures are based on the assumptions that the spill over land hit a person or the person drank water or ate fish containing the spilled chemical.

Truck Spills. For spills from trucks, doses were calculated for dermal exposures and for drinking water or eating fish containing insecticide residue. Because no studies are available on worker exposure from a truck spill, basic dermal doses were based on the assumption that a mixer/loader is exposed to 1 gallon of diluted insecticide a day. The basic dose from drinking water containing insecticide residue was calculated in the same way as for the aircraft spill. Doses from eating fish (exposure to 4-chloroaniline) are a portion of the amount of diflubenzuron in the fish.

Lifetime Exposures and Doses

To determine the risks of long-term health effects such as cancer from exposure to diflubenzuron, it is necessary to know how much of the chemical a person might get in a lifetime. For the linear cancer model (described in the hazard identification section), the total lifetime dose must be expressed in terms of average daily dose. The average lifetime daily realistic and worst case doses are summarized in table C-4.

Table C-4.--Average lifetime daily doses for realistic and worst case exposures from suppression projects (milligrams per kilogram per day)

Exposure Scenario	Suppression Projects (10 exposures)		Combined Eradication and Suppression Projects (16 exposures)	
	Realistic	Worst Case	Realistic	Worst Case
Diflubenzuron (4-chloroaniline)				
Dietary (eating fish)	0.00000011	0.0000023	0.000000079	0.0000037

Routine Operations

To find the lifetime doses from routine spraying, the following information is needed:

1. The length of the lifetime (assumed to be 70 years);
2. The type and number of gypsy moth projects that could take place in the same area during a lifetime;
3. The number of days the insecticides might be sprayed during each project;
4. The amount of chemical a person could be exposed to during each day;
5. The length of time the insecticide stays in meat, on vegetables, or in water (called persistence).

Persistence is considered only in determining lifetime doses (not in determining initial doses). Lifetime doses are based on all the doses a person could get during the time it takes for the chemical to degrade.

The two types of spraying projects generally used to control gypsy moths are eradication and suppression projects. Eradication projects are used in areas where the gypsy moth has become established by artificial means. For example, a mobile home can carry the insect into a new area where it becomes established. Suppression projects usually are conducted only in areas where the gypsy moth is established and spreads naturally.

For eradication projects, it is assumed that the area may be sprayed as many as three times over a 6-week period and that the gypsy moth could be artificially introduced into the same area twice during 70 years. Thus, in a lifetime, a person living in the same place could be exposed to insecticide six times from eradication projects.

It is assumed that the chemical is sprayed only once in each suppression project and that such a project could be conducted in the same area every 7 years. Thus, a person would be exposed 10 times over 79 years from suppression projects.

Because the gypsy moth spreads naturally and can become established in new areas, suppression projects could take place in areas that also had eradication projects.

If so, a person could get as many as 16 exposures in a lifetime (6 for eradication projects and 10 for suppression projects). A detailed discussion of how average lifetime doses are determine is on pages F-73 through F-86 of Appendix F.

Diflubenzuron (4-chloroaniline). Studies show that diflubenzuron does not cause cancer. But it is not known for sure whether a breakdown product of diflubenzuron, 4-chloroaniline, can cause cancer. Because of this uncertainty, it is assumed that 4-chloroaniline can cause cancer. The risk of cancer would come from eating meat or fish, where 4-chloroaniline can be concentrated. Because fish would have the highest level of residue, realistic and worst case doses from eating fish were calculated.

The doses of 4-chloroaniline are figured as a percentage of the estimated doses of diflubenzuron. The residues of 4-chloroaniline in fish would degrade to zero in 60 days. The doses over the 60-day period are then multiplied by the number of exposures in a lifetime and then divided by the number of days in a lifetime to get the average lifetime realistic and worst case doses from 4-chloroaniline.

Accidents

To evaluate cancer risk from accidental exposures to diflubenzuron, average lifetime doses from these exposures must be determined. (These are discussed in detail on pages F-84 through F-86 of Appendix F.) Dermal doses are multiplied by the dermal absorption rate (10 percent) and then divided by days in a lifetime to get the average lifetime dose from accidents. Oral doses are divided by days in a lifetime.

It should be noted that averaging a single large dose over 70 years creates uncertainty in the cancer risk calculations discussed in the risk evaluation section that follows. That is, the actual risks of getting cancer could be higher or lower than those presented in this analysis.

For example, a single large dose from an accident, which might occur only once in a lifetime, might overwhelm the body's normal ability to get rid of the poison or repair the damage it caused. In that case, the risk of getting cancer would be higher than the risk determined here.

On the other hand, the risk might be lower than the risk stated here. For humans, the chemical would be in the body for only one day in a 70-year lifetime. To get the cancer potency, animals were given daily doses over a period about as long as the animal's natural lifetime.

Population at Risk

For every acre sprayed, it is estimated that 14 persons from the general public could be exposed during gypsy moth operations. (A detailed discussion of how this number was determined is on pages F-64 and F-65 in Appendix F.)

Forest Service records show that on average, the insecticides have been used yearly on about 385,000 acres. Assuming an average population density of .22 person per acre, about 2.8 million people live within the Project Area.

Among these 2.8 million, some individuals or groups (for example, infants) might be more sensitive than most people to the insecticide. It is not possible to determine how many people would fall into the "sensitive category". But specific potential health effects on this group are discussed in the risk evaluation section. To be cautious, the NOELs for this group were reduced by an arbitrary safety factor of 100; that is, they are 100 times lower than those used for the general public.

RISK EVALUATION

What, then, are the health risks to workers and the general public from exposure to diflubenzuron?

To determine these risks, the estimated exposure levels (from the exposure analysis and shown in table C-2) are compared with the toxic effect levels (from the hazard identification and shown in table C-1). This comparison indicates whether harm would be caused _if_ the exposure occurs. But the odds of these exposures occurring is another question.

Some exposure scenarios are much less likely to occur than others. Because of the 10-percent correction for normal variations in mixing and spraying, even the realistic doses in the routine scenarios are higher than should occur in most sprayings. The worst case doses in the routine scenarios are far more unlikely. At most, there would be only one worst case exposure for every 500 realistic exposures.

A review of accidents in insecticide-spraying projects suggests that there would be one aircraft spill on land for about every 2,000 flights and one spill on water for about every 17,000 flights. Based on the yearly number of flights in the past, this suggests that gypsy moth projects could have about two aircraft spills every three years. Spills would involve worst case loads once every 800 years.

While truck accidents could lead to the highest exposures, these exposures are the least likely to occur. Based on national accident statistics for similar types of vehicles, trucks used in gypsy moth projects would have one accident for every three million miles traveled. Truck accidents involving spills would occur less than once every eight million miles. Assuming that trucks carrying insecticides travel an average of 100 miles per project, truck spills on land would occur once every 93,000 trips and on water once every 800,000 trips. The odds of a truck spill on land occurring in association with a worst case dose is about 1 in 50 million; on water, 1 in 460 million. (To see how these odds were calculated, see pages F-55 to F-62 in Appendix F, USDA FEIS 1985).

Threshold Responses

Comparison of threshold responses for diflubenzuron under all exposure scenarios are listed in table C-5. When the estimated dose might occur more than once, it is compared to the acceptable daily intake. High one-time doses from accidental spills are compared to the acute lethal dose for dermal exposure. (If the reader wants specific information about how many times the dose is above or below the ADI, NOEL, or LD_{50} values, refer to tables 8 through 15 on pages F-123 through F-130 of Appendix F, USDA FEIS 1985.)

It must be emphasized that the comparisons with ADIs and LD_{50}s could be misleading. The estimated doses from spraying mostly would be one-time or of short duration. Yet the ADIs are doses that can be safely taken every day for a lifetime. Because of the safety factors used to set ADIs, it may be possible that doses just above the ADI would not cause harm. However, for diflubenzuron, all doses are below the current ADI of 0.02 mg/kg/day.

For both the general public and workers, all routine exposures under the worst case lead to doses below the ADIs. All such exposures to the general public include eating food and drinking water that contain spray residues.

Table C-5.--Comparison of estimated doses to established acceptable daily intakes and acute lethal doses for diflubenzuron under different exposure scenarios

	Realistic Exposures		Worst Case Exposures	
	Relationship of Est. Dose to:		Relationship of Est. Dose to:	
Exposure Scenario	Acceptable Daily Intake (ADI)	Acute Lethal Dose (Dermal LD_{50})	Acceptable Daily Intake (ADI)	Acute Lethal Dose (Dermal LD_{50})
Routine Operations				
Workers				
Mixer/loaders	Below		Below	
Observers	Below		Below	
General Public				
Direct	Below		Below	
Drift	Below		Below	
Indirect	Below		Below	
Direct plus dietary	Below		Below	
Indirect plus dietary	Below		Below	
Observer plus dietary	Below		Below	
Dietary only	Below		Below	
Accidents				
Aircraft spill				
Dermal (partial)		Below		Below
Dermal (full)		Below		Below
Drinking water	Below		Below	
Truck spill				
Dermal		Below		Below
Drinking water	Below		Below	

Even if an estimated dose is below the ADI, it still might affect sensitive individuals. The risk analysis assumes that sensitive individuals are 100 times more sensitive to chemicals than the general population. So it is also necessary to look closely at these possible effects. The following section provides this closer look.

DIFLUBENZURON

Routine Operations--Workers. All doses are below the ADI.

Routine Operations--General Public. All doses are below the ADI.

Routine Operations--Sensitive Individuals. There may be two groups that would be at greater risk than the public at large. They are people with genetic defects that make them prone to having methemoglobin in the blood, and very young infants who lack

enzymes that can reduce the level of methemoglobin. Worst case doses that include the dietary component are roughly the same as the lowest NOEL reduced for sensitive individuals. To avoid potential ill effects in these two groups, efforts should be made to keep them from being exposed.

Accidents. All dermal exposures result in doses that are below the dermal LD_{50}. All drinking water doses are below the ADI.

Nonthreshold Responses

Cancer. The probability of cancer being caused by exposure to a chemical is determined by multiplying its cancer potency for humans (as derived through use of the linear model) by the lifetime average daily dose under each of the exposure scenarios.

The cancer probabilities are listed in table C-6. The numbers in this table are weighted lifetime risks for all exposed people. They assume a person is exposed to the chemical, but they also take into account the odds of realistic and worst case exposures occurring. (At most, there would be one worst case dose for every 500 realistic doses.) A worst case dose could raise the odds of cancer two- to twelve-fold.

Table C-6.--Weighted cancer risk to individual if exposed to insecticide under different exposure scenarios (chances in a million over a lifetime)

Exposure Scenario	Diflubenzuron[a]
Routine Operations	
Suppression projects	0.0023
Cumulative eradication and suppression projects	0.0035
Accidents	
Aircraft spill	
Dermal (partial)	0
Dermal (full)	0
Drinking water	0
Eating fish	0.0001
Truck spill	
Dermal	0
Drinking water	0
Eating fish	0.00067

[a]Statistic is for risk of cancer from 4-chloroaniline.

Diflubenzuron. The potential cancer risk from diflubenzuron comes from eating meat or fish containing 4-chloroaniline, a breakdown product of diflubenzuron. The data in table C-6 assume that a person eats meat or fish exposed to diflubenzuron.

The weighted cancer risk from eating fish or meat containing 4-chloroaniline (from the breakdown of diflubenzuron) is about 1.2 in a billion for eradication projects, 2.3 in a billion for suppression projects, and 3.5 in a billion for the combination

of both. There would be less than one incidence of cancer for every 300 million acres sprayed.

In the past, diflubenzuron has been applied to about 141,000 acres per year. Thus the added risk of cancer from using diflubenzuron could be about 0.0005 incidence per year in the exposed population of 2 million people.

Heritable Mutations

The risk of heritable mutations is based on the overall evidence of whether or not the chemicals are mutagenic in humans. As indicated in the hazard identification, diflubenzuron is considered to be non-mutagenic.

SYNERGISTIC AND CUMULATIVE EFFECTS

Because of chemicals already in the environment, it is possible that the risks from using diflubenzuron might be greater than described.

First, diflubenzuron might combine with different chemicals in the environment. By doing so, they might create effects that are greater than the sum of their separate effects. This process is called synergism. Since many possible combinations could occur, the effects of synergism are hard to predict. But based on studies of carbaryl and other chemicals, a 10-fold increase in toxic levels in isolated instances seems to be the most that could happen. This would be the worst case. Most margins of safety would still be acceptable for the general public, but sensitive individuals could be at risk.

Second, diflubenzuron might be in the environment from other sources, so gypsy moth spraying could add to amounts that are already there. Potential sources might be food and spray drift from farm areas where these chemicals are used. But data on chemical residues in food suggest that there would be little, if any cumulative effect. (For more details about synergistic and cumulative effects, see pages F-101 to F-104 in Appendix F, USDA FEIS 1985.)

CLARIFICATION OF INFORMATION ABOUT THE TOXICITY OF DIFLUBENZURON

Review of Toxicity Studies

This section describes more completely the toxicity information that was summarized in Table 3 in Appendix F. This information is being included to clarify for the reader the potential hazards of the insecticide. In addition, this information clarifies the background and basis for selecting the no-observed-effect levels (NOEL) used in the worst case analysis. This section also provides the descriptive background need to identify possible health effects resulting from exposure to diflubenzuron used to control the gypsy moth.

Acute Toxicity. Based on acute oral LD_{50} values greater than 4,640 mg/kg in rats and mice, diflubenzuron can be classified as a slightly toxic insecticide (USEPA, 1984c). The acute dermal LD_{50} for rats was reported to be greater than 10,000 mg/kg, and for rabbits it was greater than 4,640 mg/kg (USEPA, 1984c).

Chronic Toxicity. The major toxic effect observed in test subjects upon exposure to diflubenzuron is the formation of sulfhemoglobin and methemoglobin pigments in the circulatory system. Hemoglobin in its nonoxidized state is essential for the transport of oxygen, whereas the oxidized form, methemoglobin, plays no role in

oxygen transport. Investigators have suggested that there is a correlation between increased levels of methemoglobin and increased levels of sulfhemoglobin.

An 80-week mouse feeding study established a NOEL of 1.1 mg/kg/day based on the formation of methemoglobin and sulfhemoglobin in the test animals (USEPA, 1984c). A 104-week rat feeding study resulted in a NOEL of 40 ppm (2 mg/kg/day) with increased levels of methemoglobin and sulfhemoglobin observed in test animals (USEPA, 1984c). A lifetime oncogenic mouse feeding study also established a NOEL of 16 ppm (2.4 mg/kg/day) based on increased levels of methemoglobin and sulfhemoglobin (USEPA, 1984c).

Teratogenicity and Reproduction. Teratology studies in rats and mice did not result in teratogenic effects at the levels tested (USEPA, 1984c). Maternal toxicity, fetal toxicity, and teratogenic NOELS were established as being greater than 4,000 mg/kg/day (highest dose tested) for both test species (USEPA, 1984c). A three-generation rat reproduction study resulted in no reproductive toxic effects at 10, 20, 40 and 160 ppm (0.5, 1, 2, and 8 mg/kg/day) (USEPA, 1984c; Uniroyal, 1983).

Mutagenicity. Diflubenzuron was found to be nonmutagenic even at high doses (Quarles et al., 1980; MacGregor et al., 1979; and USEPA, 1984c). Concentrations of 500 mg/kg body weight did not produce a mutagenic response in hamster fetal cells (Quarles et al., 1980). Negative results also were obtained for diflubenzuron in the mouse micronucleus test in vivo, the mouse lymphoma mutation assay, and the bacterial Ames mutation assay (MacGregor et al., 1979).

Oncogenicity. No evidence of oncogenicity was observed in any test animals at doses as high as 1,000 ppm (150 mg/kg/day) in the lifetime oncogenic mouse study (USEPA, 1984c). A second oncogenic study that used rats also produced no oncogenic effects even at 10,000 ppm (500 mg/kg/day) (highest dose tested) (USEPA, 1984c). Although diflubenzuron has not been shown to be carcinogenic, one of its metabolic breakdown products, 4-chloroaniline, has been claimed to be a carcinogen. This possibility is discussed in this appendix in the section on cancer potencies.

Possible Dioxin Contamination

The concern that diflubenzuron may possibly be contaminated with "dioxin" became an issue when a list of 60 pesticides possibly contaminated with dioxin was published in the February 20, 1985, issue of Pesticide & Toxic Chemical News. The list, which was from an internal memo prepared by EPA, included diflubenzuron. After discussion with EPA, USDA was able to determine that the list included any pesticide containing a chlorine on benzene ring. EPA also informed USDA that they did not expect any 2,3,7,8-tetrachlorodibenzo-p-dioxin (the one, of 75 possible dioxin compounds, that people refer to as "dioxin") (USEPA, 1985b). Duphar B.V., the registrant of diflubenzuron, has also tested for the possible presence of 2,3,7,8-tetrachlorodibenzo-p-dioxin or tetrachlorodibenzofurans in technical grade diflubenzuron. They found no contamination using a testing method that had a sensitivity of 0.01 ppm (Shadbolt, 1985). From these discussions, USDA concluded that there was no evidence to indicate that diflubenzuron is contaminated with "dioxin".

Clarification of Cancer Potencies and Risks

This section clarifies the cancer potency of 4-chloroaniline, a breakdown product of diflubenzuron. This section also clarifies cancer risks.

Diflubenzuron (4-chloroaniline)

In the Final Environmental Impact Statement, the risks of cancer from 4-chloroaniline (resulting from the breakdown of diflubenzuron) were estimated based on secondary reports because the full data from the National Cancer Institute (NCI) study (NCI) 1979) were not available. Since then, the Forest Service has obtained the data and recalculated the risks accordingly.

The NCI conducted 2-year cancer bioassays of 4-chloroaniline in both rats and mice (NCI, 1979). Dietary concentrations of 4-chloroaniline were 0, 250, and 500 ppm for rats, and 0, 2,500, and 5,000 ppm for mice. The only cancerous tumors found that were considered to be related to the 4-chloroaniline treatment were fibromas and sarcomas in the spleen of male rats and hemangiomatous tumors in mice. In both cases, the incidences of these tumors were not significantly greater statistically than those found in untreated control animals. However, the findings were considered suggestive of carcinogenicity because of the rarity of these tumors in the spleens of rats in the colonies maintained at NCI. These cancer incidence data therefore were used to calculate the worst case cancer potency of 4-chloroaniline assuming the incidence rate to be significant.

The incidence of tumors in rats and mice was as follows:

	Dose		Incidence of Cancer		Cancer Potency	
Animal	ppm	mg/kg/day	Males	Females	Males	Females
Rats	0	0	0.05	--	--	--
	250	12.5	0	--	--	--
	500	25	0.20	--	0.034	--
Mice	0	0	0.1	0	--	--
	2,500	375	0.2	0.06	--	--
	5,000	750	0.28	0.19	0.0036	0.0038

The cancer potency, β, was calculated from the linear cancer model

$$R = \alpha + \beta d$$

For example, the cancer potency of male mice was calculated as follows:

$$R = \alpha + \beta d$$

$$0.28 = 0.1 + \beta\ (750\ \text{mg/kg/day})$$

$$= 0.00024\ (\text{mg/kg/da})^{-1}$$

To extrapolate the cancer potency in mice to humans, the cancer potency was multiplied by the 1/3 power of the ratio of human (70 kg) to mouse (0.02 kg) weight:

$$\beta(\text{Human}) = (70/0.02)^{1/3} \times 0.00024\ (\text{mg/kg/day})^{-1}$$

$$(\text{Human}) = 0.0036\ (\text{mg/kg/day})^{-1}$$

The cancer potency of 4-chloroaniline therefore could range from 0.0036 to 0.034 $(mg/kg/day)^{-1}$ depending upon which animal study was used to predict cancer in man. The arithmetic average for males of 0.019 $(mg/kg/day)^{-1}$ was used for this analysis.

Based on the recent cancer bioassays of diflubenzuron, the cancer risk from this chemical could be considered to be zero (USEPA, 1985A). However, because of the uncertainty about the carcinogenic potential of 4-chloroaniline, there may be some risk of cancer associated with exposure to diflubenzuron.

The theoretical pathways for metabolic breakdown of diflubenzuron in soil, water, plants, and animals were described in the Diflubenzuron Decision Document (USEPA, 1979). Diflubenzuron breaks down into either 4-chlorophenylurea or 2,6-diflurobenzoic acid. The 4-chlorophenylurea can further break down to 4-chloroaniline, which can then degrade to 4-chloroacetanilide. A review of the literature shows that 4-chloroaniline is rarely found in nature. The major metabolites of diflubenzuron are 4-chlorophenylurea, 2, 6-diflurobenzamide, or 2,6-diflurobenzoic acid (see USEPA, 1979, and Nimmo et al., 1984). The principal exceptions were fish and animals, with fish having as high as 60 percent of the total diflubenzuron residue found as 4-chloroaniline (USEPA, 1979). Rapid depletion of the residues in fish was reported in the Diflubenzuron Decision Document, but no data on persistence were given.

Arguably, the cancer bioassays for diflubenzuron also have measured the cancer risk associated with 4-chloroaniline because this metabolite would result from any breakdown. However, if a person consumed large amounts of meat or fish containing diflubenzuron, and therefore 4-chloroaniline residues, then he or she possibly could be exposed to higher levels of 4-chloroaniline than were fed the mice and rats in the cancer bioassays. Therefore, the risk of cancer associated with this possible exposure was analyzed.

The realistic and worst case doses of diflubenzuron resulting from residues in fish were estimated to be 0.00003 mg/kg/day (0.06 x 0.0004 mg/kg/day x 1.1) and 0.0006 mg/kg/day (0.06 x 0.0051 mg/kg/day x 2.0) on page F-44 (USDA FEIS, 1985). If 60 percent of diflubenzuron is broken down to form 4-chloroaniline, the 4-chloroaniline doses would be 0.0000096 mg/kg/day (0.00003 mg/kg/day x 0.6 x 127.6/210.7) for the realistic case and 0.0002 mg/kg/day (0.0006 mg/kg/day x 0.6 x 127.6/210.7) for the worst case. (The value 127.6/210.7 is the ratio of molecular weights.) Since no persistence data are available, it was assumed that 4-chloroaniline residue in the fish would degrade to zero within 60 days.

The average dose over the 60-day period therefore would be 0.0000048 mg/kg/day (realistic) or 0.0001 mg/kg/day (worst case). The realistic lifetime dose of 4-chloroaniline resulting from eradication projects is then:

d = 0.0000048 mg/kg/day x 60 days/project x 6 projects/lifetime x 1/25,550 days/lifetime

$d = 6.8 \times 10^{-8}$ mg/kg/day

The worst case average lifetime dose of 4-chloroaniline from eradication projects is:

d = 0.0001 mg/kg/day x 60 days/project x 6 projects/lifetime x 1/25,500 days/lifetime

$d = 1.4 \times 10^{-6}$ mg/kg/day

The average lifetime doses resulting from suppression projects were calculated by multiplying the eradication doses by 1.67, which yields 1.1×10^{-7} and 2.3×10^{-6} mg/kg/day for the realistic and worst case, respectively.

The cancer risk to an individual exposed to diflubenzuron, and therefore possibly to 4-chloroaniline, is calculated as follows for the realistic case from eradication projects:

$$R = \beta d = 0.019 \ (\text{mg/kg/day})^{-1} \times 6.8 \times 10^{-8} \ \text{mg/kg/day}$$
$$= 1.2 \times 10^{-9}$$

Cancer risks to an individual for other realistic or worst case doses are presented below:

	Eradication		Suppression	
	Lifetime Dose	Lifetime Cancer Risk	Lifetime Dose	Lifetime Cancer Risk
Realistic	6.8×10^{-8}	1.2×10^{-9}	1.1×10^{-7}	2.2×10^{-9}
Worst Case	1.4×10^{-6}	2.7×10^{-8}	2.3×10^{-6}	4.5×10^{-8}

The cancer risk from accidental spills of diflubenzuron were based on the assumption that an individual would eat 0.5 kg of fish taken from the stream in which the chemical was spilled. To evaluate the risk of cancer from accidental exposure, the single high dose resulting from dermal exposure, water consumption, or fish consumption needs to be expressed in terms of average lifetime dose.

Lifetime Incidences of Cancer Per Acre

To estimate the number of possible incidences of cancer per acre over a lifetime series of applications, the cancer risk is multiplied by the population at risk (14 individuals/acre based on assumptions stated on pages F-64 and F-65 in Appendix F). This translates to the lifetime incidences of cancer per acre for the lifetime number of applications:

Insecticide/ Exposure Scenario	Incidences of Cancer/Acre/Lifetime: Suppression (for 10 applications)	Incidences of Cancer/Acre/Lifetime: Eradication (for 6 applications
Diflubenzuron		
Eating fish/meat	3.2×10^{-8}	1.7×10^{-8}

In a site-specific environmental assessment, total incidences of cancer in the population can be calculated for a single application by dividing incidences of cancer per acre per lifetime by the number of applications (6 or 10) and multiplying by the total number of acres proposed for treatment. For example, for suppression projects, incidences of cancer are calculated as follows:

Diflubenzuron	
Eating fish/meat	No. of acres $\times 3.2 \times 10^{-9}$

In other words, there would be less than one incidence of cancer if diflubenzuron were sprayed on 300 million acres.

Accidents

The cancer risks associated with the accident scenarios for diflubenzuron is shown in table C-7.

Table C-7.--Cancer risks for accidents with diflubenzuron

Aircraft Spill		
Eating fish	1.0×10^{-10}	1.8×10^{-10}
Truck Spill		
Eating fish	6.7×10^{-10}	1.2×10^{-9}

The estimated oral doses that result from a person drinking water that contains insecticide residues are based on the following assumptions:

- The insecticide is applied directly to water (contrary to normal operating procedures);

- Water sources will have a minimum average depth of 6 inches;

- Realistic insecticide concentrations are 50 ppb (0.05 mg/liter) for every 1 lb. a.i. per acre application. Worst case concentrations are 0.707 mg/liter for every 1 pound a.i. per acre application of insecticide;

- Daily consumption of water is 2 liters;

- Water consumed is from a surface spring or stream that had direct application;

- Actual persistence times depend on many environmental factors, but data from gypsy moth projects indicate that residues do not remain in running water for more than 2 to 6 days (see, for example, LOTEL, 1975, and Pieper, 1979). Persistence can be much longer in stagnant water bodies (Giggs et al., 1984), but these are much less likely sources of drinking water;

- It is possible that after spray application, some insecticide might be dislodged by rain within 10 days (based on half-life data) (FEIS, table 2), and runoff into potable water. This may result in a brief increase in the concentration of insecticide in water. The transitory nature of these residues and the relatively small contribution of drinking water to human exposure compared to the dermal exposure values already estimated (p. F-32) indicate that runoff is not a significant contribution factor for exposure and is thus not considered in this analysis.

APPENDIX D

APPENDIX D

BIOLOGICAL PESTICIDE BIOBURDEN

The following letter reviews the concern that some *Bacillus thuringiensis* products may contain disease-causing organisms and concludes that there is no hazard to human health associated with the use of *Bt* in forestry applications.

United States Department of Agriculture

Forest Service

WO

Reply to: 2150

Date: April 27, 1988

Subject: Biological Pesticide Bioburden

To: Regional Foresters, Station Directors, and Area Director

The safety of products containing Bacillus thuringiensis var. kurstaki Berliner (Bt) has recently been questioned. Several Forest Pest Management staffs, including the Washington Office, have investigated these concerns and we wish to clarify the situation as we understand it.

This letter summarizes information collected from the U.S. Environmental Protection Agency (EPA), the Food and Drug Administration, concerned publics, and private industry sources. As a result of our data collection activities, we do not feel that forest pest control efforts intending to use Bt will require additional product testing. We recommend that projects proceed in accordance with the Federal Insecticide, Fungicide, Rodenticide Act, as amended, the National Environmental Policy Act, as well as other applicable laws and regulations.

The safety of conventional chemical pesticides used in forest pest management programs has long been questioned. Now the biologicals have been drawn into the picture. For example, questions concerning the safety of Bt stem from rumors of potential human illness, including vomiting and diarrhea, along with rumors of disease-causing microorganisms in Bt products (sometimes characterized as the Bt bioburden). These rumors, to date, have been determined to be without basis in scientific fact.

The U.S. Environmental Protection Agency has also reviewed the situation and it is our understanding that they too believe the concerns about Bt are unjustified. Discussions with the product manager for biological pesticides have resulted in our concluding that EPA believes that neither human health nor environmental problems have been demonstrated previously nor do they expect any now.

In over 18 years of Bt use, there have been no scientifically-documented cases or evidence of Bt-caused illness directly attributable to forestry-use situations. This long history of use and a special study on the health effects of Bt spray programs conducted by the Oregon Department of Human Resource's Health Division between 1985-87 have not resulted in any cause and effect relationships between Bt use and human illness. Thus, they appear to corroborate the apparent safety of this biological pesticide.

Low levels of extraneous microorganisms do exist in Bt; however, these low levels do not affect the overall safety of Bt. The same environmental bacteria are also present at similar levels in water, food, milk, and other dairy products. The chances of exposure to low levels of extraneous microorganisms may be greater from eating or drinking ordinary food products than from Bt use in forestry.

Another concern recently expressed was the possibility of enterotoxins (e.g. intestinal or enteric streptococci such as Streptococcus faecalis and S. faecium) being present in Bt products. Manufacturers of Bt products advise us that due to steps taken in the manufacturing process, it is unlikely that enterotoxins would be present in distributed products.

A final concern has been Bt contamination of food or feed. Given, current information, and under forestry use conditions, the probability of Bt contaminating food or food products is highly unlikely. During all the years of Bt use in agriculture and forestry, no evidence has been seen that Bt grows on food, produces enterotoxins, significantly increases the bioburden, or causes unacceptable contamination.

Manufacturers of Bt products are required by law to test each lot of Bt technical material produced. Each lot is tested for pathogenicity and vertebrate toxicity. Therefore, additional testing by the FS is believed unnecessary. At this time, we concur with EPA's analysis that there is no hazard to human health associated with the use of Bt in forestry. However, should managers of individual spray programs wish to independently test products, we have enclosed a protocol for sampling products delivered to treatment locations. Also included are recommended testing methodologies and an indication of appropriate test facilities.

In summary, after reviewing these concerns and possible alternative approaches to dealing with them, we have decided not to initiate an independent product testing and analysis program at this time. We believe projects planning to use Bt and/or other microbial pesticides should proceed as planned. In the meantime, the Forest Service will continue to monitor new information and advise you of any changes in the agency's position.

/s/ Allan J. West

ALLAN J. WEST
Deputy Chief

Enclosure

cc: Abbott Laboratories, Inc.
Sandoz Crop Protection, Inc.
NOVO Laboratories, Inc.
Mike McDonald (USDA-OBPA)
W.E. Stewart, AgCanada
James Space (WO-FPM)
M. Ollieu (WO-FPM)
D. Hamel (WO-FPM)
P.Hutton, EPA

FPM:DHAMEL/DRH/4:27:88

RECOMMENDED PROTOCOL FOR SAMPLING AND TESTING PESTICIDES
FOR MICROBIAL ANALYSIS IN COOPERATIVE FOREST PEST MANAGEMENT PROJECTS
F.Y. 1988

INTRODUCTION:

The USDA Forest Service (FS) is not requiring testing of products used in forestry spray programs since we believe that there is no human health hazard to be associated with spraying Bt. However, if independent testing is done, the following procedures are highly recommended for use in order to assure test validity.

Sampling technique is critical; contamination of products can come from inappropriate sampling technique, therefore only trained personnel should handle the sampling procedures.

Once the testing is complete, the data interpretation may be difficult. It will not be uncommon to find extraneous microorganisms in Bt preparations. However, no adverse effects have ever been reported to be associated with the presence of these extraneous organisms. Therefore, drawing conclusions from the data regarding the safety should be done with extreme care.

I. SAMPLING:

1. For each lot number of concentrate collect two samples. One sample will be used for testing and one sample will be used for back-up. Where tanker trucks are concerned, collect two samples from each tank-car compartment.

2. Prior to drawing the samples, agitate the drum by turning it over at least ten times. If an automatic drum roller is available, roll the drum at least 15 times. Where samples are to be drawn from tank trucks, the sampling must be performed when the truck arrives at the delivery site. Sufficient mixing of product will occur during transport.

3. Collection bottles must be sterile and rubber gloves should be worn during the taking of samples. It is recommended that 125 ml widemouth Nalgen bottle or similar collection device be used. Where possible, use square bottles to facilitate storage. Sterile pipettes must be used for transferring materials from the container to the sterile bottle. Where dry powders are used, do not agitate the container; use a sterilized scoop to transfer the material from the container to the sterile bottle. Samples taken should fill bottles 3/4 full.

Extreme care must be taken not to contaminate the sampling bottle or bottle cap during sampling. In order to assure proper sampling technique, sampling crews should be State health officials or certified microbiologists. If a microbiologist is not available, contact your nearest FPM Field Office for additional advice. Do not attempt to collect samples unless the sampling personnel are adequately trained in public health microbiological techniques.

4. Label the sample with a "Sharpie" or other type of indelible pen. Write directly on the bottle. This will ensure that the label information does not wash off if the bottle becomes wet. Each bottle should be labeled with the following data:

a. Product Name, Lot Number, EPA Establishment No., when available (not the EPA Registration Number).

b. Date sampled.

c. Name, Affiliation, and Title of Collector: (Example: Dave Smith, Health Inspector, State Department of Public Health).

d. Location of Sampling.

e. Time sample was collected.

f. Where possible, remove the product label and ship it with the sample.

5. After the sample has been collected, immediately place the bottle in a refrigerator or cooler with ice and hold until samples are shipped. (Do not hold samples in cold storage any longer than two weeks before shipping. Do not freeze samples prior to shipping).

6. Ship all samples as quickly as possible to an appropriate microbiological testing laboratory with the capability to follow the procedures outlined herein.

II. TESTING:

Enterococci Screening: NOTE: Observe aseptic precautions throughout the test.

Enterococcosel Agar: Use Baltimore Biological Labs Enterococcosel Agar, No. 12205. Prepare and sterilize according to the manufacturer's directions.

Sample Preparation: Aseptically transfer 10.0 g or ml of the sample into a flask containing 90 ml of sterile, ph 7.2, phosphate buffer. NOTE: It may be necessary to dilute further so that 1 ml of the final dilution will be expected to yield between 30 and 300 colonies.

Procedure: Transfer 1 ml of each of the sample preparation dilutions into each of 2 sterile Petri dishes. Promptly add to each dish 15 to 20 ml of Enterococcosel Agar medium, previously melted and cooled to 46 to 50 degrees Centigrade (C). Cover the dishes, mix dishes, and allow contents to solidify at room temperature. Invert the dishes and incubate at 35-37 degrees (C) for 72 hours. Count the number of typical enterococci (brownish-black colonies surrounded by a black zone in the agar). Determine the average count. Confirm the presence of enterococci by gram strain--enterococci are gram positive cocci in chains--of a typical colony. Multiply the average count of the confirmed enterococci by the dilution factor, and report the result as the number of enterococci colonies per gram of sample.

III. COLIFORM SCREENING

Coliform Screening: NOTE: Observe aseptic precautions throughout the test.

Violet Red Bile Agar: Use Baltimore Biological Labs Violet Red Bile Agar, No. 11807. Prepare and sterilize according to the manufacturer's direction.

Sample Preparation: Aseptically transfer 10.0 g/ml of the sample into a flask containing 90 ml of sterile, pH 7.2, phosphate buffer. NOTE: It may be necessary

to dilute further so that 1 ml of the final dilution will be expected to yield between 30 and 300 colonies.

<u>Procedure</u>: Transfer 1 ml of each of the sample preparation dilutions into each of 2 sterile Petri dishes. Promptly add to each dish 15 to 20 ml of Violet Red Bile Agar medium, previously melted and cooled to 46 to 50 degrees (C). Cover the dishes, mix the test solutions and the medium by tilting and rotating the dishes, and allow contents to solidify at room temperature. Invert the dishes, and incubate at 30-35 degrees (C) for 24-48 hours. Count only the number of typical coliform colonies, purplish red colonies of 1 to 2 mm diameter surrounded by reddish zone of precipitated bile in the agar. Determine the average count. Confirm the presence of coliforms by gram stain-- coliforms are gram negative rods-- of a typical colony. Multiply the average count of the confirmed coliforms by the dilution factor and report the result as the number of coliform colonies per gram of sample.

IV. <u>INTERPRETIVE GUIDELINES</u>

There are no definitive standards for acceptable levels of extraneous microorganisms in Bt preparations. Enterococci and coliforms should be used as indicator organisms because high numbers of these organisms signify the potential for the occurrence of truly pathogenic organisms. However, currently there are no established standards for these indicator organisms in microbial pesticides. The mere presence of these organisms has not been demonstrated to affect the safety of Bt products.

A normal Bt preparation contains 10^{10} Bt spores per ml. It is common practice to regulate impurities at levels of 0.1% or greater, which would be 10^7 organisms per ml.

In order to assure a 10^2 margin of safety, an arbitrary level of 10^5 enterococci per ml is being set for guidance, and a 10^3 level of coliforms. These levels are arbitrary and are for guidance purposes only (10^5 enterococci per ml translates into 0.001% impurity; 10^5 coliforms per ml translates into 0.00001% impurity). Numbers of these organisms higher than the listed guidelines would suggest that additional testing may be required.

In this case, contact the nearest Forest Pest Management Office since we have made arrangements with some Bt manufacturers to take an extra, aseptically-collected file sample of end-use product for potential followup testing by the agency. These samples will be analyzed by the agency or an independent contractor to settle discrepancies in levels of microbial bioburden identified by users.

APPENDIX E

APPENDIX E

SUMMARY OF RECENT RESEARCH STUDIES ON ENVIRONMENTAL FATE OF DIFLUBENZURON (1986-1988)

The following recent studies on the environmental fate of diflubenzuron are summarized for the reader. This is not an all-inclusive list, but only those studies that were found by the EIS Team during literature reviews for this document. In general, the studies support the relative safety of diflubenzuron when applied at registered rates to the forest environment.

Blumberg, A. Y. 1986. Survey of aquatic, soil and soil surface invertabrate fauna in a North Carolina forest (pre- and post-application of dimilin WP-25) Final Report. Duphar B. V. WEESP, Holland, Int. Doc. No. 56635/24/86. 42 pp.

Description - A 10-acre forest in North Carolina was treated with diflubenzuron at 2 oz. a.i. per acre for a field dissipation study. Bio-samples were collected from various environmental compartments.

Results - No obvious trends in population number of invertebrate fauna were evident that could be reasonably attributed to the effects of the application of diflubenzuron.

Jones, A. S. and Lochenderfer, J. N. 1986. Persistence of diflubenzuron (Dimilin) in a small eastern watershed and its impact on invertebrates in a headwater system. (Progress Report). Duphar B. V. S. Graveland, The Netherlands. Document No. 1417. 9 pp.

Description - A 74-acre watershed on the Fernow Exp. Forest in West Virginia was treated with diflubenzuron at the rate of 0.06 lbs active ingredient (1 oz a.i./ac). A 96 acre watershed served as a control. Residue samples (pre and post treatment) were collected for a field persistence study. Residue samples were collected from water, sediment and forest floor. Samples were also collected to determine the amount of insecticide reaching the stream. At 45 minutes post-spray, the first of seven rainfall events occurred during the one week post-spray period.

Results - Analysis of petri dishes from stream channels showed that from 2.25 to 27.4 g/ha reached the stream, depending on the amount of canopy closure. Analysis of water samples for stream residues for the first 20 hours after spray application revealed levels of 100 ppt immediately after application. At 45 minutes post-spray, heavy rain occurred and residues in the stream increased to 2.1 ppb, and quickly fell back to 100 ppt after the rain event stopped. Thereafter, residues of diflubenzuron decreased below the limits of detection, 25 ppt by 19 hours post-spray. Analysis of sediment and forest floor samples as well as invertebrate samples was not completed at the time of this report.

Kingsbury, P., K. M. S. Sundaram, S. Holmes, R. Nott and D. Kreutzweiser. 1987. Aquatic fate and impact studies with Dimilin. Forest Pest Management Institute, Canadian Forest Service. Sault Ste. Marie, Ontario. File Report No. 78. 45 pp.

Description - A 25-ha (62 acre) forest block was treated with diflubenzuron to evaluate fate and impact on two pond ecosystems. Both ponds were directly sprayed with diflubenzuron at an application rate of 70 g active ingredient per ha (0.5 oz a.i./ac).

Results - The rate of dissipation of the chemical was rapid in all substrates studied with non-detectable levels (<0.10 ppb) observed in 20 days for water, 5 days in sediment, 10 days in aquatic plants and three days in fish. The greatest effect was on crustacean zooplankton, especially cladocerans. Recovery of populations of even the most severely affected organism was well established by three months after treatment.

Martinat, P. J., V. Christman, R. J. Cooper, K. M. Dodge, R. C. Whitmore, G. Booth and G. Seidel. 1987. Environmental fate of Dimilin 25-W in a central Appalachian forest. Bull. Environ. Contam. Toxicol. 39: 142-149.

Description - An aerial application of 0.5 oz a.i. per acre of diflubenzuron was made to an oak forest in West Virginia to control gypsy moth. A two year study was initiated to study the environmental fate of diflubenzuron in litter, foliage, arthropods, and insectivorous forest birds.

Results - The overall trend in all samples was that of decreasing residue levels over time. On day 21, residues in canopy birds were .09 ppm while those in low foraging and ground birds had dropped below detection limits (less than 0.03 ppm). Residue levels in foliage and canopy insects were higher than those in canopy feeding birds, indicating that diflubenzuron does not bioaccumulate at higher tropic levels.

Martinat, P. J., C. C. Coffman, K. Dodge, R. J. Cooper, and R. C. Whitmore, 1988. Effect of diflubenzuron on the canopy arthropod community in a central Appalachian forest. J. Econ. Entomol. 81(1): 261-267.

Description - Canopy arthropods were sampled in a two year study following the aerial application of diflubenzuron (Dimilin 25W, .5 oz a.i./ac) for the control of gypsy moth.

Results - Besides reductions in gypsy moth larvae, significant reductions due to diflubenzuron were found in canopy macrolepidoptera and non-lepidopteran mandibulate herbivores. Sucking herbivorous insects, microlepidoptera, and predaceous arthropods were not affected. The study concluded that the effects of Dimilin on forest bird population due to reductions in canopy insect was probably minimal.

Mutanen, R. M., H. T. Siltanen, V. P. Kuukka. 1988. Residues of diflubenzuron and two of its metabolites in a forest ecosystem after control of the pine looper moth, Bupalus Piniarius L. Pestic. Sci. 23: 131-140.

Description - Diflubenzuron was used to control the pine looper in a 1160-ha (2,866 acre) stand of Scots pine in eastern Finland. Residues of diflubenzuron and two of its metabolites, 4-chloroaniline and 4-chlorophenylurea, were determined in water, pine needles, litter, humus, boleti and other wild mushrooms.

Results - In water samples taken from the treated area, diflubenzuron was still detected at concentrations of 0.1 ug per litre two months after application. No diflubenzuron was detected in the area the following year, nor outside the treated area. Neither metabolite was detected at any time. After two months, no residues were detected in groundwater. Residue in litter and humus decreased from 0.6 to 0.5 mg per kg in one week. Residues increased in one plot from 0.6 to 1.4 mg per kg the following year in the litter layer, probably due to needle fall during the autumn.

Sundaram, A., A. Retnakaran, A. G. Raske, and R. J. West. 1987. Effect of application rate on droplet size spectra and deposit characteristics of Dimilin spray. Pesticide Formulation and Application Systems: Seventh Volume, ASTM STP 968, G. B. Beestmain and D. I. B. Vander Hoover, Eds, Am. Soc. for Testing and Materials, Philadelphia, pp. 104-115.

Description - Diflubenzuron (Dimilan 25WP) was aerially sprayed as an aqueous suspension over four 15-ha (37 acre) plots in coniferous forests in Newfoundland using different volume and emission rates of application.

Results - The higher emission rate of 48.13 L/min resulted in larger droplets, higher droplets/cm^2, and greater recovery of the applied spray volume at ground level. The lower emission rate of 20.48 L/min had smaller droplets, lower droplet/cm^2, and a smaller percent recovery at ground level. It was concluded that the lower application rate might provide a better target coverage at canopy level, with minimum ground contamination.

Sundaram, K. M. S., A. Sundaram and R. Nott. 1987. Droplet deposits and persistence characteristics of diflubenzuron in forest litter and soil after aerial application of Dimilin WP-25 formulation at three volume and emission rates. Duphar, B. V. WEESP, Holland. 29 pp.

Description - Droplet deposits and persistence characteristics of diflubenzuron in forest litter and soil were studied after aerial application of Dimilin WP-25 at 70 g a.i. per hectar, using three volume (10, 5, and 2.5 L/ha) and emission (120, 60 and 30 L/min) in a mixed forest near Kaladar, Ontario.

Results - The maximum concentration of the chemical found in the highest volume and emission were for litter, 6.46 ppm three hours post-spray and for soil, 1.03 ppm six hours post-spray. Residues dissipated to undetectable levels (less that 0.05 ppm) within seven days. The study concluded that diflubenzuron does not persist in forest soil and litter and vertical downward mobility is practically absent.

Van den Berg. 1986. Dissipation of diflubenzuron residues after application of Dimilin WP-25 in a forestry area in North Carolina and some ecological effects. (Summary Report). Duphar B. V. WEESP, Holland Report No. 56637/47/1986. 11 pp.

Description - A 10-acre forest in North Carolina was treated with diflubenzuron at 2 oz. a.i. per acre (four times normal application rate used for gypsy moth suppression) for a field dissipation study. Residue samples were collected from water, soil, sediment and foliage.

Results - Diflubenzuron residues of 0.1-0.2 ppb were measured in water at day one and dropped below detectable levels (below 27 ppt) from the third day onward. In sediment, no residues were detected. In soil, residues were 0.02 mg/kg at day one and declined below detectable levels after 14 days. On leaves, after 63 days about 25 percent of the original residue was left.